JPA Designer

SAP 9.92 module • U-value modules & Condensation Risk

Version 6.02a1 and above

ISSUE FEBRUARY 2015

JPA TL Ltd.
Newcastle Business Village,
33 Bellingham Drive,
North Tyneside Ind. Est.,
Newcastle upon Tyne NE12 9SZ

T: 0191 270 5138
E: sales@techlit.co.uk
W: www.techlit.co.uk

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Part I

JPA Designer basics

1 Introducing JPA Designer

Welcome to JPA Designer, the design and calculation program from JPA TL Ltd. JPA Designer can:

- carry out SAP calculations to SAP versions 9.92, 9.90, 9.81, 9.80 and 9.70, to demonstrate compliance with the energy efficiency requirements of Building Regulations and Building Standards[1] and as part of Code for Sustainable Homes (CSH) assessments;
- lodge On-construction Energy Performance Certificates (EPCs) for dwellings in England and Wales, Scotland and Northern Ireland;
- assess PV and wind turbine output calculations for feed-in tariff installations;
- calculate U-values for building elements;
- carry out condensation risk analysis to BS EN ISO 13788;

JPA Designer includes many features to make the calculation process easier:

- Project-based file system enables you to keep all the calculations for one development in same project file;
- U-value templates to speed up calculations.
- Links between U-value and SAP calculations, so that SAP calculations are automatically updated when U-value calculations change;
- Calculation results can be produced as PDF files for emailing;
- A database of common materials to speed U-value calculations;

We hope you find JPA Designer a useful calculation tool. We are always happy to receive comments, suggestions for improvements or proposals for enhancements to suit your specific needs.

[1] In order to lodge and issue EPCs you will need to be a member of an accreditation scheme (England and Wales, Northern Ireland) or protocol organisation (Scotland). You can find details of our partner schemes at www.techlit.co.uk/training/accreditation.

1.1 Conventions for the manual

The manual uses the following conventions:

- <angled brackets> for keys on the computer keyboard, e.g. the <Enter> key.
- the **+** sign indicates you should hold down one key while pressing another, e.g. <Alt+F> means 'hold down the <Alt> key while pressing the <F> key'.
- **Bold type** indicates parts of JPA Designer's screen displays, e.g. the **Ventilation rate** dialogue.
- **Menu**>**option** indicates an option in a menu on the program's menu bar, e.g. Select **Edit**>**Primary heating system** means *click on the* ***Edit*** *menu and select* ***Primary heating system*** *from the list*.

This manual uses the following special terms:

- **Dialogue (dialogue box)**: a small window which displays text boxes or buttons for entering data.
- **Radio button**: a set of two or more related buttons - you can only select one at a time.
- **Tick box**: a box which lets you turn a setting on (ticked) or off (not ticked).
- **Text box**: an area on a dialogue in which you can type words or numbers.
- **List**: a box on a dialogue which can be expanded to show a number of pre-set options, usually by clicking an arrow on the right-hand side of the box.

Many functions of JPA Designer can be accessed using either the menus or the toolbars: also, some may also have keyboard shortcuts. To avoid repetition this manual refers only to the menus.

1.2 Getting help

If you have a problem with the *functioning* of the software please follow these steps:

- Download and install the latest version of JPA Designer from our web site (see section 2.2 for instructions) and see if that resolves the problem.
- Check the forum and FAQ on our web site (http://forum.techlit.co.uk) to see if the problem is addressed there.
- If the problem persists, email details of the problem to *support@techlit.co.uk*. Please include details of your computer system and attach sample files or PDF outputs where possible. We will respond as soon as we can.

If you have difficulty *using* the program (for example, you are uncertain how to enter a layer in a condensation risk calculation) please follow these steps:

- Consult the program manual or on-line help system;
- Check the forum and FAQ on our web site (http://forum.techlit.co.uk) to see if the query is addressed there;

If you are new to condensation risk calculations we offer distance learning and on-line training training courses, which provide a thorough introduction to the software and its use. You can find more details at http://www.techlit.co.uk/training.

2 Getting started

This section of the manual describes how to install JPA Designer on your PC and explains how the user registration and on-line licence checking systems work. It also includes instructions on adding your company details and logo to reports.

2.1 System requirements

JPA Designer runs on Windows XP, Vista, 7 and 8 (see Technical Note 2012/04). Apple Macintosh users can run JPA Designer on a Windows virtual machine under Parallels Desktop or VMWare Fusion, or on a Windows installation using Boot Camp (we do not offer technical support for installing JPA Designer on such systems).

Whatever computer you are using it will require an internet connection to check the validity of the licence, to update the BRE Product Characteristics Database for the SAP 2012 module and to issue EPCs.

2.2 Installation

To install JPA Designer on your PC:

1. Go to our web site at www.techlit.co.uk and *right click* on the link labelled *download JPA Designer*: select **Save link as** or **Save target as** (the exact wording will depend on which the browser you are using).

2. Save the installer file **jsetup990.exe** to your PC (we recommend downloading the file to the Desktop). The download is about 13 MB.

3. When the download is complete double click on the file **jsetup990.exe**. The InstallShield Wizard configures itself and, after a few moments opens.

   *You may see a security warning that the publisher of the file could not be identified. If you do, click **Run** to continue the installation process.*

4. Click **Next** to continue with installation. The installer displays the **Licence Agreement**. To continue with the installation click *I accept the terms of the licence agreement*, then click **Next**.

5. At the **Customer information** screen enter your name and company name and, using the radio buttons, select whether you want JPA Designer to be available to all user accounts on the computer, or just one. (We recommend you select *all*.) Click **Next**.

6. At the **Choose Destination Location** screen we recommend you accept the default settings and install JPA Designer into the folder **c:\program files\jpatl\jpa designer 981**. Click **Next**. The installer will now copy the JPA Designer files onto your computer.

7. When installation has finished the **Setup Complete** screen is displayed. Tick the box labelled **Launch the program** and click **Finish**. The installer will close and **JPA Designer** will open, showing you the **Project Manager** window.

2.3 User registration

In order to use JPA Designer you must enter valid user registration details and the program must be able to check the status of your licence against our licensing database. We supply the user name and key code when you buy a licence for a module. If you do not enter your details JPA Designer runs in *demonstration mode* and will not display the results of calculations.

To enter license details for a module:

1. At the **Project Manager** window (Figure 2.1) select **Edit**>**User and Security Codes** from the menu bar. The **User Registration** dialogue opens (section 2.3).

2. In the section for the module (e.g. the U-value module) enter the company name – exactly as supplied in the registration email – in the box **Your company name**.

   *The company name is case sensitive and should be entered exactly as shown in the email: so if, for example, you enter **Limited**, when the company name with the key code contained **Ltd** the program will not accept the key code.*

3. Copy the key code from the registration email and paste it into the bottom box on the **User Registration** dialogue.

4. Click the **Apply … code** button for the module. The program copies the code into the **Key code** boxes for the module.

If you have bought several modules repeat the steps for each one.

2.4 On-line licence checking

JPA Designer checks the validity of your licence for a module the first time you open a calculation after the the program has started. It does this by contacting our on-line licensing database and checking the expiry date for module[1].

[1] The process only looks for the company name and checks the licence status and expiry date on the database.

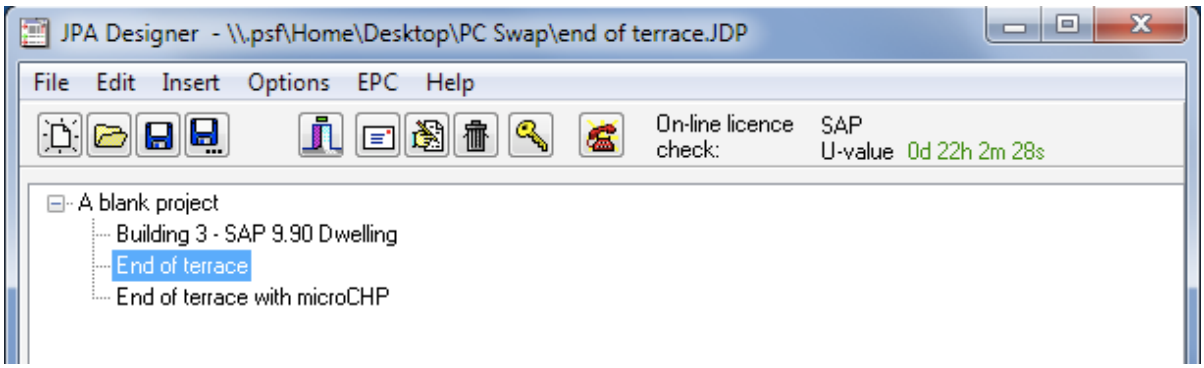

JPA Designer - \\.psf\Home\Desktop\PC Swap\end of terrace.JDP
File Edit Insert Options EPC Help
On-line licence check:
SAP U-value 0d 22h 2m 28s
A blank project
Building 3 - SAP 9.90 Dwelling
End of terrace
End of terrace with microCHP

Figure 2.1: The Project Manager window

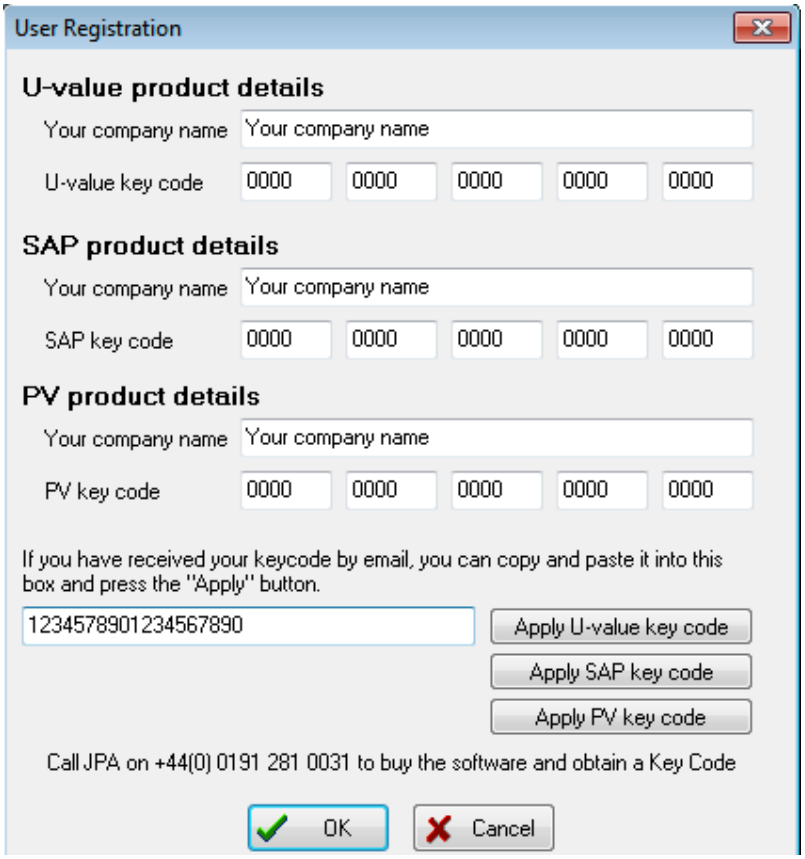

User Registration
U-value product details
Your company name
Your company name
U-value key code
0000 0000 0000 0000 0000
SAP product details
Your company name
Your company name
SAP key code
0000 0000 0000 0000 0000
PV product details
Your company name
Your company name
PV key code
0000 0000 0000 0000 0000
If you have received your keycode by email, you can copy and paste it into this box and press the "Apply" button.
12345789012345678900
Apply U-value key code
Apply SAP key code
Apply PV key code
Call JPA on +44(0) 0191 281 0031 to buy the software and obtain a Key Code
OK
Cancel

Figure 2.2: The User Registration dialogue

- If the check is successful and the licence is valid the module will open. (The program will record the date and time of that successful check).
- If the program is unable to connect with the database (for example, because you are using your lap-top away from your office) it will look at the date of the last successful check: if that is less than seven days ago then the module will open.
- If the program is unable to connect with the database and the last successful check is more than seven days ago then it will **not** open the module.
- If the check is successful and the licence is not valid the calculation will not open.

If you often use JPA Designer away from the office there are two features you can use to prevent problems with the licence check:

- The **Project Manager** tool bar displays the length of time since the last successful licence check: provided the values shown are *green* the module will open.
- The **Check licence on-line** button on the tool bar will force a licence check and re-set the time since the last check to zero. You should force a check if you expect not to have an internet connection for a few days.

2.5 Updates

JPA Designer is continually being developed to introduce new features: to get the best from the program it is worth making sure you are using the latest version. You can find the version number by selecting **Help**>**About** from the menu bar in JPA Designer and compare that with the version number shown on our web site[2] (www.techlit.co.uk).

Higher numbers and letters indicate later releases, with characters coming earlier in the name being more important that later ones: so 4.05a1 will be more recent than 4.04c2, and 4.05b1 more recent than 4.04a4. The three digit *Build* number indicates a minor change in a version. Figure 2.3 shows the **About** dialogue for JPA Designer together with the version number on the web site: in this case the software is up to date, as both version numbers are the same.

The process for updating the software is identical to that of originally installing it[3] (see section 2.2).

You can find details of the changes in each version on the announcements section of our web forum[4].

2.6 Opening and closing JPA Designer

To open JPA Designer:

- Select **Programs**>**JPA Designer**>**JPA Designer** from the Windows **Start** menu.

Figure 2.3: The About dialogue showing the version number

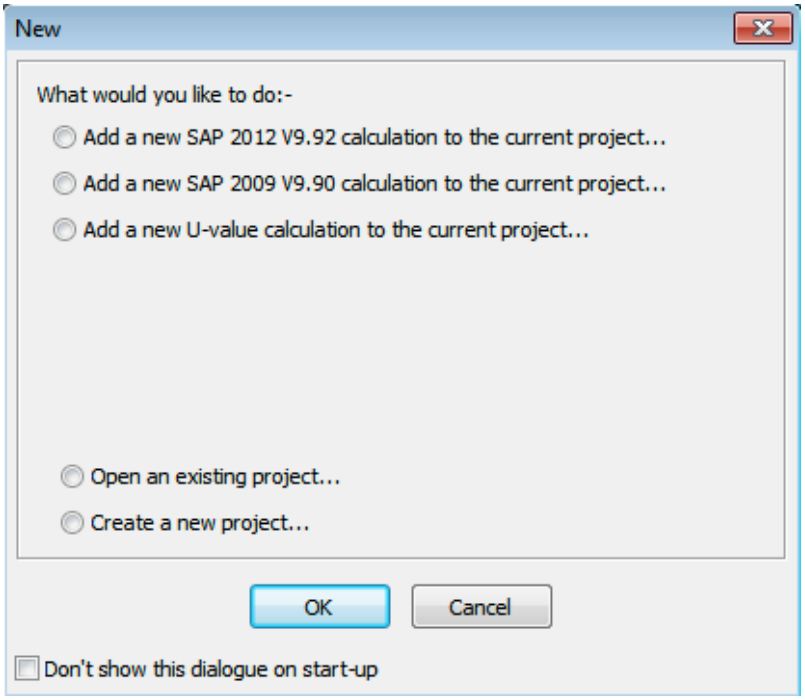

New
What would you like to do:-
Add a new SAP 2012 V9.92 calculation to the current project...
Add a new SAP 2009 V9.90 calculation to the current project...
Add a new U-value calculation to the current project...
Open an existing project...
Create a new project...
OK
Cancel
Don't show this dialogue on start-up

Figure 2.4: The new splash screen for JPA Designer

A splash screen (Figure 2.4) appears when you open JPA Designer. This allows you to add new calculations to a blank project, or to open an existing project. There is an option not to display the screen when the program starts-up.

To close JPA Designer:

- Select **File**>**Exit** from the JPA Designer menu bar. The program will prompt you to close any files which have not been saved.

2.7 Uninstalling JPA Designer

To uninstall JPA Designer:

1. Open the Windows **Add/Remove programs** control panel (to access Control Panels select **Settings**>**Control Panels** from the **Start** menu).
2. Select JPA Designer in the **Add/Remove Programs Properties** dialogue and click **Add/Remove**. Windows will uninstall the program files and remove its icons.

Uninstalling the program will not remove any JPA Designer project files.

2.8 Adding your company details to reports

Most of the reports produced by JPA Designer can be customised to include your company name, address and logo. The details are added using **Options** dialogue from the main **Project Manager** window (see section 18.5). The logo must be a 256 colour BMP format file[5].

It is also possible to set up details for several different companies within JPA Designer: these sets of address details and logos are referred to as identities (see section 2.8). You can switch between identities to produce calculation reports with different addresses and logos.

Setting up address details

To set up your company details and logo for reports:

1. In the Project Manager window, select **Options** from the menu bar. The **Options** dialogue opens.
2. In the **General** tab enter your company name, address, phone and email details in the *Company name & address* section (see Figure 2.5).

[2] www.techlit.co.uk

[3] If you are using a version earlier than 5.02a3 you will have to uninstall the program using the Windows **Add/remove programs** or **Uninstall programs** control panel.

[4] http://forum.techlit.co.uk/viewforum.php?f=13

[5] If you have the company logo in a different format, such as a jpeg, tiff or png, you can use the free Paint program which comes with most versions of MS Windows™ to convert it to the right format and to set the correct colour depth.

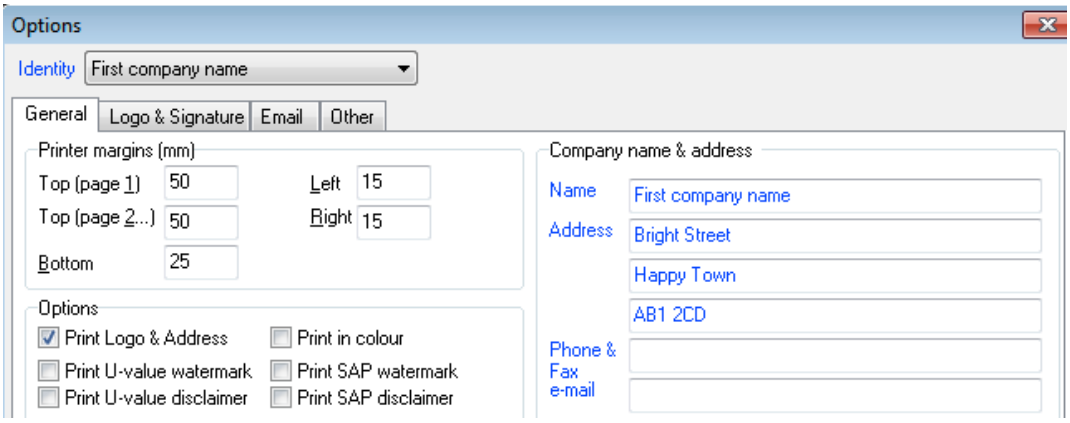


Figure 2.5: The Options dialogue - General tab

3. Tick the **Print Logo & Address** box.
4. Enter the wording of any disclaimers which you want to appear at the bottom of U-value and SAP reports in the **U-value disclaimer** and **SAP** boxes.
5. If you have entered wording for the U-value and/or SAP disclaimers tick the **Print U-value disclaimer** and/or the **Print SAP disclaimer** boxes.
6. Click the **Logo & Signature** tab.
7. In the *Logo position* section enter the location of the **Top** and **Left** sides of the logo, relative to the page, and enter the **Width** of the logo. All dimensions should be in millimetres. *It will probably take some experimentation to get the logo position and size correct.*
8. Enter the name of the **Logo file**, including the *.bmp* extension, then click **OK** to close the dialogue.
9. Copy or move the logo file to the folder containing the user data. On Windows 7 this will be **c:\ProgramData\JPA\JPA Designer**.

   *Note: The **Certificate signature position** and associated settings are no longer in use.*

If you are a competent person under the TIMSA/BBA U-value competency scheme you can configure JPA Designer to add the scheme logo to your calculations:

1. Click the **Logo & Signature** tab.
2. In the *TIMSA logo position* section enter the location of the **Top** and **Left** sides of the logo, relative to the page, and enter the **Width** of the logo. All dimensions should be in millimetres.

   It will probably take some experimentation to get the logo position and size correct.
3. Enter the name of the **Logo file**, including the *.bmp* extension, then click **OK** to close the dialogue.

4. Copy or move the logo file to the folder containing the user data. On Windows 7 this will be **c:\ProgramData\JPA\JPA Designer**.
5. If you want the TIMSA logo to be used by default tick **Default to print TIMSA logo**.

   *You can always override the default setting in the **Sections To Print** dialogue.*

Setting up identities

The procedure for setting up identities is similar to that for setting address details:

1. Enter the details for the first company as described in section 18.5.
2. Re-open the **Options** dialogue.
3. In the **Identity** list select the first blank identity (usually labelled *Blank 1*). The *Company name & address* and disclaimer information will be cleared.
4. Enter the details for the second company, including the data in **Logo and signature** tab. Click **OK** to close the dialogue and save the data.
5. Repeat steps 2–4 for any further identities.

As you add identities they will be added to the **Identities** list, using the **Name** of the company in the list. If you need to edit the data for any one of the identities, select it from the **Identities** list, make the changes and click **OK**.

When you come to create a PDF of a report or to print it you will be able to select one of the identities to use the associated details in the header. Note that whichever identity you select when producing a report, the report footer will always show the name of the company or individual holding the licence.

3 Managing projects and calculations

This chapter explains how JPA Designer stores calculations and describes how to work with project files and calculations. It describes how to use calculation templates to speed up the calculation process.

3.1 The project file

JPA Designer organises and saves calculations in project files, which have the extension **JDP**. You can save multiple calculations in the same file.

Calculations are created, saved and managed in the JPA Designer **Project Manager** window (Figure 2.1), which lists all the calculations in the current project.

3.2 Starting a new project

Whenever you start JPA Designer the program creates a new blank project which you can use straight away. You can also create a new project at any time by selecting **File**>**New Project** from the main menu, or clicking the **New Project** button on the toolbar.

You can change the default project name **A blank project** to something more useful:

1. Click once on the project name and select **Edit**>**Rename selected item**. The **Project name** dialogue opens (Figure 3.1).
2. Enter the new name for your project, then click OK.
3. The project is renamed

   The project name does not affect the calculations in any way.

3.3 Adding project address details

You can enter client address and site details for a project, which you can then copy to all the individual calculations within that project. You can enter and edit that information using the **Project Address** dialogue (Figure 3.2). You can also store client address information to reuse in other projects.

To add client and project details:

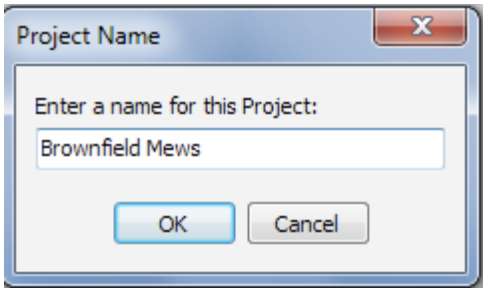


Figure 3.1: Changing the name of a project

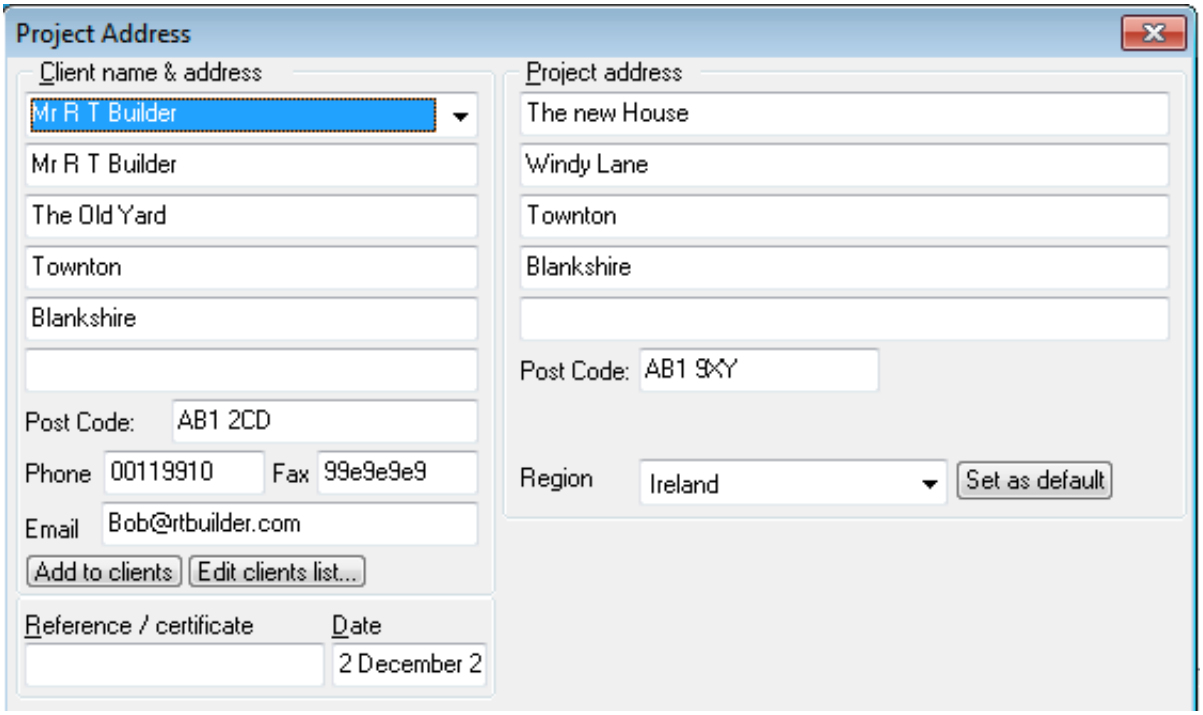


Figure 3.2: The Project Address dialogue

1. From the menu bar select **Edit**>**Project Address**. The **Project Address** dialogue opens.
2. Enter the data by typing it into the appropriate boxes. Use the <Tab> key to move between boxes.

   Do not try to enter data in the top left hand box: this box is used for retrieving details you have previously stored.
3. If you want to store the client details to re-use later click **Add to clients**.
4. Click **OK** when you have entered all the data you need.

To copy the project address details to all the calculations in a project:

1. Enter the address details in the **Project Address** dialogue.
2. Click **Pass down**.

3. Click **Yes** at the confirmation dialogue.

4. Once the copying is done click **OK**.

You can also copy project address details to individual calculations once you have opened the calculations (see section 4.1).
To re-use existing client data simply click on the list at the top of the **Project information** dialogue and select a client name (Figure 3.3).
If you need to edit the details held for clients click **Edit clients list** then make the changes in the **Edit Clients** dialogue.

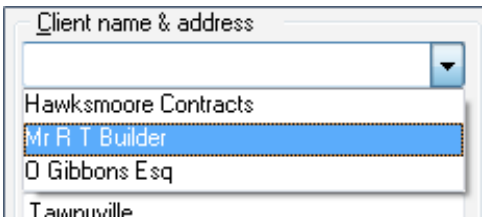


Figure 3.3: The client name and address list

3.4 Setting the calculation region

JPA Designer is designed to carry out the thermal calculations required in different regions of the world. Some regions require U-value calculations, while others require R-value calculations: some regions only consider one-way heat flow while others require two-directional heat flow (see Table 3.1. The region settings also determine the climate data available for condensation risk analysis.

Table 3.1: Regional calculation settings

Region	Calculation type	Heat flow
Asia	U-value	Heat-out
Australia	R-value	Heat-in/ heat-out
Ireland	U-value	Heat-out
Middle East	U-value	Heat-in/ heat-out
New Zealand	R-value	Heat-in/ heat-out
UK	U-value	Heat-out

The calculation region can be set in the **Project Address** dialogue (see Figure 3.2):

1. Select the **Region** in the list.

2. Click **Set as default**.

3. All new calculations will use that region.

You can override the region setting for individual calculations in the **Project Information & Options** dialogue.

3.5 Saving projects

JPA Designer project are saved in the same way as any other file:

1. From the menu bar select **File**>**Save Project**. The **Save As** dialogue opens.
2. Select the folder into which the project should be saved, enter a name for the project file.

   *By default JPA Designer will add the extension **JDP** to all file names.*
3. Click **Save**. JPA Designer saves the project and displays the file name on the program title bar.

By default JPA Designer will save files into the JPA Designer user data folder (on Windows 7 usually **c:\ProgramData\JPATL\JPA Designer 981**). You can specify a different default folder by specifying the *startup* folder using the **Options** dialogue).

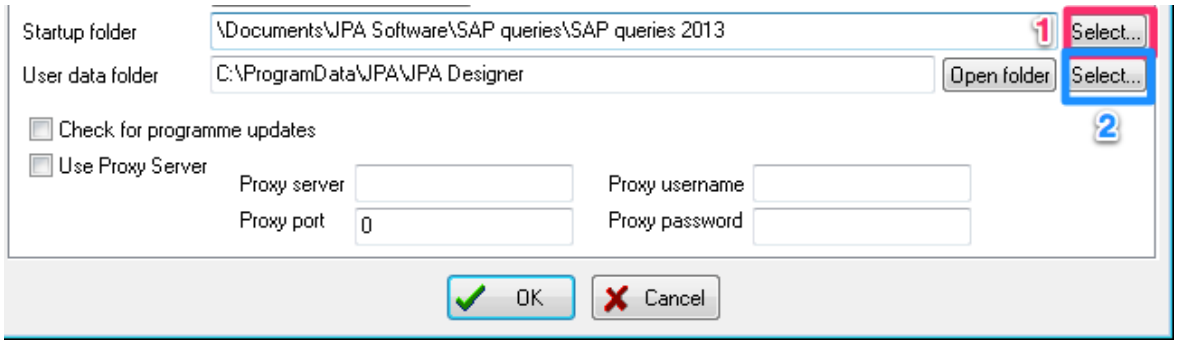


Figure 3.4: Startup folder controls in the Options dialogue

To specify the *startup* folder:

1. From the menu bar select **Options**.
2. On the **General** tab click the **Select** button for the **Startup folder** (item 1 in Figure 3.4).
3. In the **Browse For Folder** dialogue select a folder and click **OK**.
4. The folder will now be the default location for saving JPA Designer files and PDF files of calculation reports.

We recommend you have a regular back-up schedule for your data.

3.6 Opening projects

To open an existing project:

1. From the menu bar select **File**>**Open project**. The **Open** dialogue opens.
2. Select the file you want to work with, then click **Open**. The project opens in the **Project Manager** window.

3.7 Adding calculations to a project

You can add new calculations to a project in the **Project Manager** window.

To add a new U-value calculation to a project:

1. From the menu bar select **Insert**>**U-value calculation**. The **Description** dialogue opens (Figure 3.5).
2. Type a name for the calculation in the **Description** dialogue, e.g. *warm roof,* and click **OK**. The new calculation is added to the project.

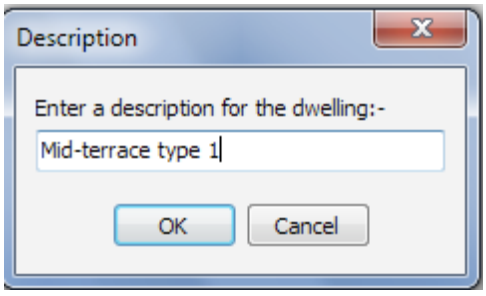


Figure 3.5: The Description dialogue

To add a new SAP calculation to a project:

1. From the menu bar select **Insert**>**Dwelling/SAP (v9.92 2012) calculation**>**Single dwelling**. The **Description** dialogue opens (Figure 3.5).
2. Type a name for the calculation in the **Description** dialogue, e.g. *Plot 23*, and click **OK**. The new calculation is added to the project.

You can also use the Insert menu to insert calculations to versions 9.90, 9.81, 9.80 and 9.70 of SAP, as well as SAP calculations for multiple dwellings. Follow the same basic procedure to add PV assessment and Psi-value assistant calculations to a project.

When naming U-value and SAP calculations avoid using the Windows restricted characters ' /\ : * ? < > |, otherwise you will have problems creating PDFs of calculation reports (see chapter 12 for a more detailed explanation.

3.8 Using U-value calculation templates

JPA Designer offers a range of standard U-value calculations, which you can use to speed up the calculation process and minimise repetitive work. We refer these standard calculations as U-value templates. Each template contains the same information as a normal U-value calculation including element definitions, layers with bridging details and correction factors.

You can either use the template 'as is' without modifying it, or use it as a starting point to produce your own calculation, but whichever route you chose, the calculation process will be quicker.

There are three types of U-value template:

- *standard templates for roofs, walls and floors*. These are generic calculations which can be adapted by changing materials and thicknesses. They are supplied with the program.
- *manufacturers' templates*. A number of construction product manufacturers have supplied U-value templates for typical constructions featuring their products. The templates are supplied with the program[1].
- *user-defined templates*. These are calculations which you have previously performed and then saved as a template, enabling you to build up a library of commonly used calculations. See section 3.8 for instructions.

Inserting a U-value calculation from a template

The controls for inserting U-value calculations based on templates are at the bottom of the **Project Manager** window (Figure 3.6). To insert a new U-value calculation based on a template:

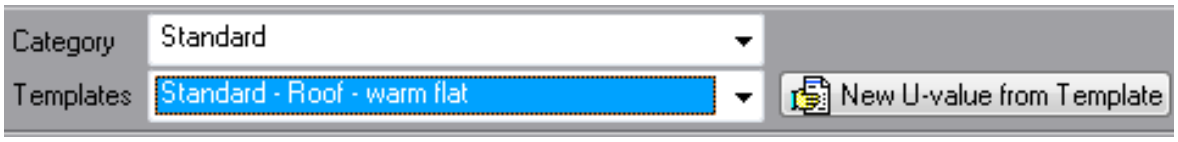


Figure 3.6: The template selection controls

1. In the **Categories** list select the *type* of template you want. That may be a manufacturer's category, one of the default categories, or a template group you have created previously.
2. In the **Templates** drop-down list pick the template you wish to use.
3. Click **New U-value from Template**. The **Description** dialogue opens.
4. Edit the name of the template to suit your project, or accept the default name. Once you are ready, click **OK**.
5. A new U-value calculation is added to the project.
6. You can now open and edit the calculation by double-clicking on its name in the **Project Manager** list.

Creating user defined templates

You can create templates from your own U-value calculations by saving them in JPA Designer template files, which have the file extension JTF. You can have several different template files which allows you to sort the calculations into groups: you might have one

[1] If you are a manufacturers of construction materials you can add U-value calculations which include your materials into the set of templates which is distributed with JPA Designer. Offering U-value calculations with your materials makes it easier for designers to include them in U-value calculations and specifications and helps to ensure the materials are included in calculations correctly. Please contact JPA TL Ltd for information and current pricing.

for wall calculations and one for floor calculations, alternatively, you might divide them into masonry or timber framed calculations.

The simplest way to create a template file is to use the **Import U-value** feature to collect all the existing U-value calculations you want available into one project then save the project as a template file.

To import an existing U-value calculation to a project:

1. Start a new project in JPA Designer: on the **File** menu click **New**.
2. On the **File** menu click **Import U-value from another JPA Designer project**.
3. In the **Open** window select the file which contains the calculation.
4. At the **Import U-value from Project** dialogue (Figure 3.7)select the U-value calculation from the list and click **OK**.
5. The U-value calculation is added to the open project.
6. Repeat the process to import all calculations you want into the project.

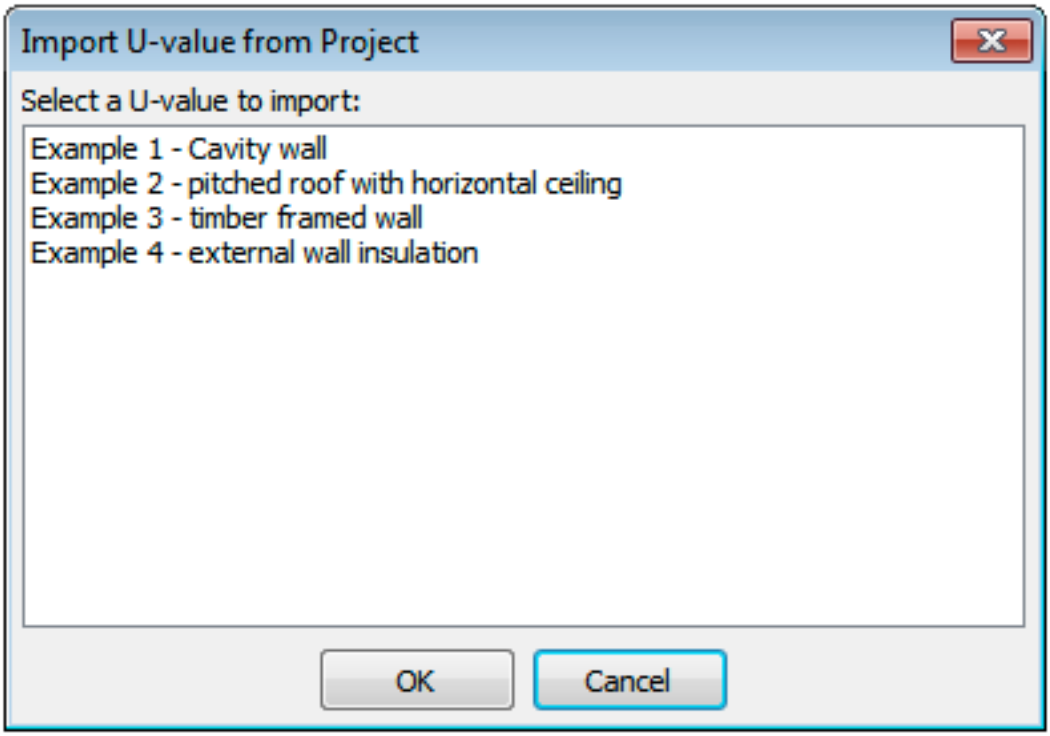

Import U-value from Project
Select a U-value to import:
Example 1 - Cavity wall
Example 2 - pitched roof with horizontal ceiling
Example 3 - timber framed wall
Example 4 - external wall insulation
OK
Cancel

Figure 3.7: The Import U-value dialogue

You can, of course, create new calculations for the template if you want to.

The name which appears in the **Categories** list is taken from the *project name* in the Project Manager window. So before you save a template file you should change the *project name* to something which will help you identify the calculations from the list (Figure 3.8)[2].

To set the *project name*:

[2]The default *A Blank Project* will be no help at all a few weeks after you have created the template.

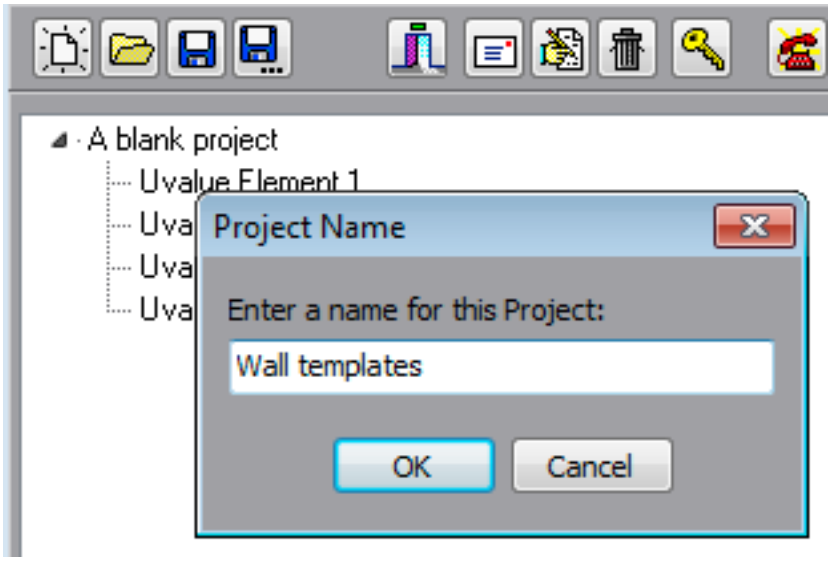


Figure 3.8: Changing the *project name*

1. In the **Project Manager** window double click on the *project name* – the default value is *A blank project*.
2. In the **Project Name** dialogue type a new name for the project.

The template file must be saved in the same folder as the other JPA Designer user data files and in the JTF format. To save a project as a template:

1. On the **File** menu click **Save Project as Template**.
2. Enter a *File name*.
3. Set the folder to the user data folder (in Windows 7: **c:\ProgramData\JPA\JPA Designer**).
4. Make sure **Save as type** is set to *JPA Designer U-value Template (JTF)* and click **OK**.
5. Your template project is now included in the **Categories** list.

3.9 Opening and closing calculations

To open a calculation from the **Project Manager** window, either:

- double click on the calculation name; or,
- click once on the calculation name, then from the menu bar select **Edit**>**Selected item**.

To close a calculation and return to the **Project manager** window click the **Project manager** button on the tool bar.

3.10 Duplicating calculations

If you want to carry out a calculation which is very similar to an existing calculation in a project you can duplicate the calculation and then change the copy, leaving the original calculation untouched. To duplicate a calculation:

1. In the **Project Manager** window click once on the calculation to select it.
2. From the menu bar select **Edit**>**Duplicate item**. The **Description** dialogue opens.
3. Type a name for the duplicate calculation and click **OK**. A copy of the original calculation is added to the project.

   *When naming a calculation avoid using the Windows restricted characters ' /\ : * ? < > |, otherwise you will have problems creating PDFs of calculation reports (see chapter 12) for a more detailed explanation.*

You can now work with the duplicate calculation in the usual way.

3.11 Importing U-value calculations

When you need to re-use an existing U-value calculation in a new project you can import a copy of the calculation from its original project into a new one.

To import a calculation into the current project:

1. On the **Program Manager File** menu select **Import U-value from another JPA Designer project**.
2. In the **Open** dialogue select the project containing the original U-value calculation. Click **OK**.
3. In the **Import U-value from Project** dialogue click on the calculation to select it, then click **OK**. The U-value calculation is copied into the current project.

Importing existing U-value calculations into a new project is a quick way of building a set of U-value templates (see section 3.8).

3.12 Converting between SAP versions

JPA Designer can convert SAP calculations carried out under one version of SAP to a later version of SAP. You may need to do this when the Building Regulations compliance calculation is based on a previous version of SAP, but the EPC has to be issued using the current version of SAP. The program takes a copy of the data from the original calculation and converts the copy to the required version, leaving the original calculation untouched.

You can convert:

- SAP 2009 (V9.90) to SAP 2012 (V9.92);
- SAP 2005 (V9.81) to SAP 2009 (V9.90);

- SAP 2001 (V9.70) to SAP 2005 (V9.80/9.81);
- SAP 2009 (V9.90) to SAP 2005 (V9.81).

Once you have carried out the conversion you should check the new calculation. Where building services information has been taken from the boiler database (SAP 2001 and SAP 2005) or the Product Characteristics Data File (SAP 2009 and SAP 2012) you should re-select the systems in the converted calculation.

To convert a SAP 2009 (V9.90) calculation to SAP 2012 (V9.92):

1. In the **Project Manager** window select the SAP 2009 calculation.
2. From the menu bar select **Edit**>**Copy selected SAP V9.90 2009 dwelling to a V9.92 2012 dwelling**.
3. JPA Designer creates a copy of the original calculation as a SAP 2012 calculation. The copy has the same name as the original, but appended with *SAP version 9.92*.
4. Open and check the calculation, particularly the services section.

To convert a SAP 2005 (V9.81/9.80) calculation to SAP 2009 (V9.90):

1. In the **Project Manager** window select the SAP 2005 calculation.
2. From the menu bar select **Edit**>**Copy selected SAP V9.8x 2005 dwelling to a V9.90 2009 dwelling**.
3. JPA Designer creates a copy of the original calculation as a SAP 2009 calculation. The copy has the same name as the original, but appended with *SAP version 9.90*.
4. Open and check the calculation, particularly the services section.

To convert a SAP 2001 (V9.70) calculation to SAP 2005 (V9.80):

1. In the **Project Manager** window select the SAP 2001 calculation.
2. From the menu bar select **Edit**>**Copy selected SAP V9.70 2001 dwelling to SAP 9.80 2005 dwelling**.
3. JPA Designer creates a copy of the original calculation as a SAP 9.80 calculation. The copy has the same name as the original, but appended with *SAP version 9.80*.

*The 9.80 calculation can then updated to 9.81 by ticking the **SAP version 9.81** box in the **Project Information** dialogue in the SAP module (see section 18.5)*

1. When you open the 9.80 calculation you will be prompted to add additional details which were not required by the earlier version of SAP.

To convert a SAP 2009 (V9.90) calculation to SAP 2005 (V9.81):

1. In the **Project Manager** window select the SAP 2009 calculation.
2. From the menu bar select **Edit**>**Copy selected SAP V9.90 2009 dwelling to a V9.81 2005 dwelling**.
3. JPA Designer creates a copy of the original calculation as a SAP 2005 (V9.81) calculation. The copy has the same name as the original, but appended with *SAP version 9.81*.
4. Open and check the calculation, particularly the services section.

Finally, it is also possible to import SAP 1998 (9.60) calculations from JPA SAP v2[3] and convert them to SAP 9.70:

1. From the menu bar select **Import JPA SAP file into this Project**.
2. In the **Open** dialogue select the JPA SAP file you wish to import.
3. JPA Designer creates a copy of the original calculation as a SAP 2001 (V9.70) calculation.

3.13 Renaming calculations

To change the name of a calculation:

1. In the **Project Manager** window click once on the calculation to select it.
2. From the menu bar select **Edit**>**Rename selected item**. The **Name** dialogue opens.
3. Enter a new name for the calculation and click **OK**. The **Project Manager** window shows the new name.

   *When naming a calculation avoid using the Windows restricted characters ' /\ : * ? < > |, otherwise you will have problems creating PDFs of calculation reports (see chapter 12 for a more detailed explanation.*

Changing the name of the calculation will not affect the calculation results.

3.14 Deleting calculations

Calculations can be deleted from JPA Designer projects.
WARNING: there is no way of recovering a deleted calculation.
To delete a calculation:

1. In the **Project Manager** window click once on the calculation to select it.
2. From the menu bar select **Edit**>**Delete selected item**. JPA Designer asks you to confirm the deletion.
3. Click **Yes** to delete the calculation or **No** to abandon the deletion. If you click **Yes** the calculation is removed from the project.

[3] JPA SAP v2 was the precursor of the JPA Designer SAP module.

3.15 Merging projects

Using the **Merge projects** function you can copy all the calculations in an existing project into the currently open project. This can be useful if you have a number of standard calculations stored in different projects which you need to bring together for a particular job. Merging does not change the project you are copying *from*.

To merge calculations from one project into another:

1. In **Project Manager** open or create the project you want to *receive* the calculations.
2. From the menu bar select **File**>**Merge a project from disk into this Project**. The **Open** dialogue appears.
3. Select the file which *contains* the calculations and click **Open**. JPA Designer adds the calculations to the current project and lists them in the **Project Manager** window. You can now edit them without affecting the original project.

Part II

U-value calculations

4 The JPA Designer U-value modules

JPA Designer offers two U-value modules:

- **U-value 2014** calculates U-values for walls, roofs and intermediate floors using the combined method (BS EN ISO 6946: 2007) and also calculates U-values for ground floors to BS EN ISO 13370:2007.
- **U-value 2014 Professional** has the functionality of U-value 2014 and also performs condensation risk analysis using the methods set out in BS EN ISO 13788:2012.

U-value calculations are carried out in the U-value module by:

1. Entering project information (section 4.1).
2. Entering key information about the building element, such as the element type (e.g.wall, floor, roof) and any special construction types (e.g. metal frame) (chapter 5);
3. Defining the different layers which make up the element (chapter 7);
4. Adding correction factors for factors such as mechanical fasteners and air gaps in insulation layers (chapter 8).
5. Printing calculation results, or creating PDF files of the results for emailing (chapter 12).

You can test the effect different materials have on the thermal performance of the element by using the variable layer feature (section 9.4).

4.1 U-value project information

JPA Designer can store client and project details for each calculation and then add them to calculation reports. You can either the copy client and project details which you entered in the **Project Information** dialogue in the **Project Manager** window, or you can enter new data in the U-value modules. You can also save and re-use client data (see section 3.3). In either case you can select the **Region** for the calculation (see section 3.4 for an explanation of how region settings affect calculations).

To copy project details from Project Manager:

1. In the U-value module select **Edit**>**Project Information** from the menu bar. The **Project Information** dialogue opens.
2. Click the **Inherit** button.
3. At the prompt choose whether you want the calculation to inherit the region settings for the project or not[1].
4. Any information you entered in Project Manager is copied to the **Project Information** dialogue here.
5. Click **OK**.

To enter new project details:

1. In the U-value module select **Edit**>**Project Information** from the menu bar. The **Project Information** dialogue opens.
2. Enter project information by typing it into the appropriate fields. Use the <Tab> key to move between fields.
3. If you need to use a region other than the default, select the new **Region** in the list.
4. Click **OK** when you have entered all the data you need.

To copy project details from the current calculation to all other calculations in project:

1. Enter the address details in the **Project Information and Options** dialogue.
2. Click **Pass down**.
3. At the **Information** dialogue click **Yes**.

[1] In most cases you will want to inherit the project region settings.

5 Construction details

The thermal performance of building element will be affected by the type of element and its position within a building. These conditions are set in the **U-value Construction** dialogue (Figure 5.1), which accepts details of:

- The type of element (e.g. roof, wall, floor), together with additional information for some elements (section 5.1).
- The conditions at the internal and external surfaces (see section 5.2).
- Details of any light steel frame construction (see section 9.1).
- Details of twin-skin metal roofing or cladding (see section 9.2).
- Corrections factors for mechanical fasteners (see chapter 8).
- Adjustments for the effects of unheated spaces (see section 8.5).

To enter data:

1. From the menu bar select **Edit**>**Construction type**. The **U-value Construction** dialogue opens.
2. Enter your data and click **OK**.

For some constructions, such as those with mechanical fasteners, you may find it easier to enter some of the data in the construction dialogue *after* you have entered the layers of the element.

5.1 Element type

JPA Designer recognises several types of element which have to be treated differently in the calculation process. Use the radio buttons in the **Element type** section to select the type of floor, wall or roof. Some elements have options for entering additional information.

The available element types are:

- Flat roof. A roof with a pitch typically less than 10°. There is an option to enter data for an inverted roof (section 9.3).

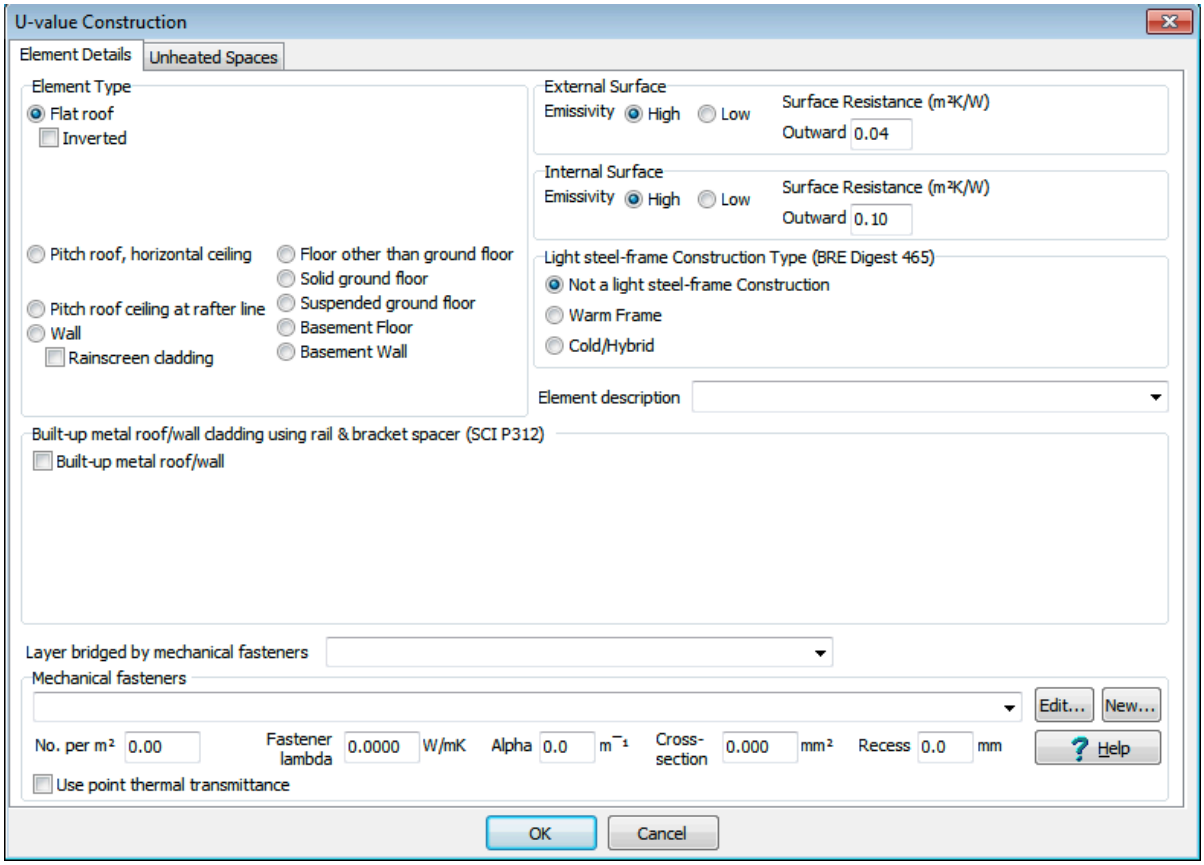


Figure 5.1: The U-value Construction dialogue

- Pitched roof with horizontal ceiling. Typically a 'cold roof' with the insulation applied between and over the ceiling joists. You must enter the pitch (angle) of the roof, measured from the horizontal.

  This element type may also be used to model a roof with a horizontal ceiling, but insulation at rafter line.

- Pitched roof with ceiling at rafter line. A *warm roof* with the insulation in the plane of the rafters.

- Wall. Any construction at an angle of more than 70° to the horizontal. There is an option to enter data for the fixings in rainscreen cladding (section 8.4).

- Floor other than ground floor. A floor over an open space (e.g. a parking bay) or an unheated space (e.g. an enclosed garage).

- Solid ground floor. A floor which is contact with the ground across its whole area, such as groundbearing concrete slab.

- Suspended ground floor. A floor with a ventilated space below the floor deck, such as a beam and block floor or timber joist floor.

- Basement floor.

- Basement wall.

You may also enter a description for the element in the **Description** box, or select one from the drop-down list. The description does not affect the calculation

5.2 Internal and external surfaces

U-value calculations take account of the heat flow at the internal and external surfaces of an element by means of the internal and external *surface resistances*. Those resistances are affected by the direction of heat flow through the construction and the emissivity of the exposed surfaces.

The surface resistances used in the calculation are shown in the two **Surface Resistance** boxes. The program sets the surface resistances based on the element type (section 5.1) and the emissivity of the surfaces, using the values from BS EN ISO 6946 shown in Table 5.1.

The default emissivity setting is *high emissivity* which suits the great majority of facing materials[1]. You can, of course, replace the default resistances with your own values in the very rare cases where that is necessary.

Table 5.1: Thermal resistances

Heat flow	Element	Internal resistance (Rsi)	External resistance (Rse)
Horizontal	Wall	0.13	0.04
Upwards	Roof	0.10	0.04
Downwards	Floor	0.17	0.04

5.3 Light steel frame construction type

U-values for light steel frame structures have to be calculated using a special method which allows for the high thermal conductivity of steel. The **Light steel-frame Construction Type** section indicates whether the structure has a light steel frame, and if so, whether it is of warm or cold construction.

For non-steel frame structures ensure **Not a light steel frame construction** is selected. For instructions for calculating U-values of light steel frame structures see section 9.1.

[1] There are very few conditions where it is necessary to set the emissivity to low.

6 Working with layers

Each U-value calculation is built up by inserting layers which correspond to the different materials in the construction. For example, a U-value calculation for a cavity wall would have a layer to represent each of:

- the outside surface resistance;
- the outer leaf of brickwork;
- the cavity;
- the cavity insulation;
- the inner leaf of masonry;
- the plaster finish;
- the internal surface resistance.

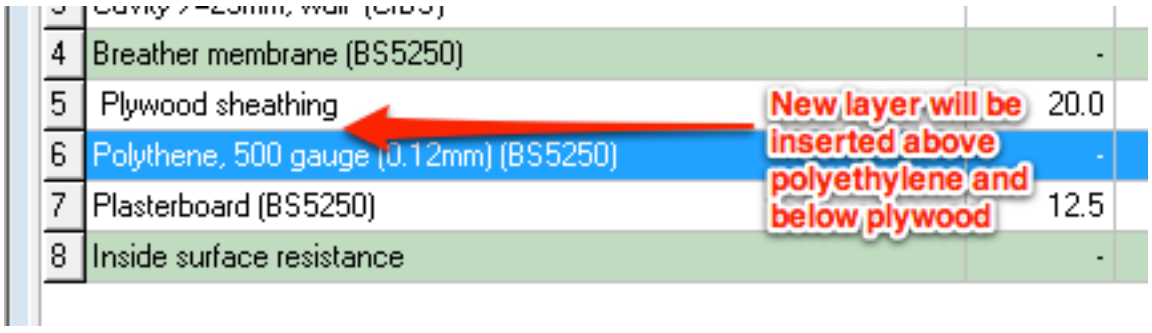

4 Breather membrane (BS5250) -
5 Plywood sheathing 20.0
6 Polythene, 500 gauge (0.12mm) (BS5250) -
7 Plasterboard (BS5250) 12.5
8 Inside surface resistance -
New layer will be inserted above polyethylene and below plywood

Figure 6.1: The new layer will be inserted *above* the selected layer

You can add layers to the calculation by inserting materials from the program's extensive database, which includes data for generic materials and cavities, as well as branded products from a number of manufacturers. For many common constructions it is possible to insert all the layers from the database. If you cannot find a material in the database then you can insert a blank layer and edit the information yourself.

The program always adds a new layer directly *above* the currently selected layer, so in Figure 6.1 the new layer would be inserted above the polyethylene and below the plywood sheathing.

When you start a calculation you should select the lowest layer (which will be the inside surface resistance for walls and roofs, and the outside surface resistance for floors) before beginning to add layers. Because layers are of this it is quicker to work from outside to inside for wall and roof calculations and from inside to outside for floor calculations.

6.1 Inserting layers from the Products database

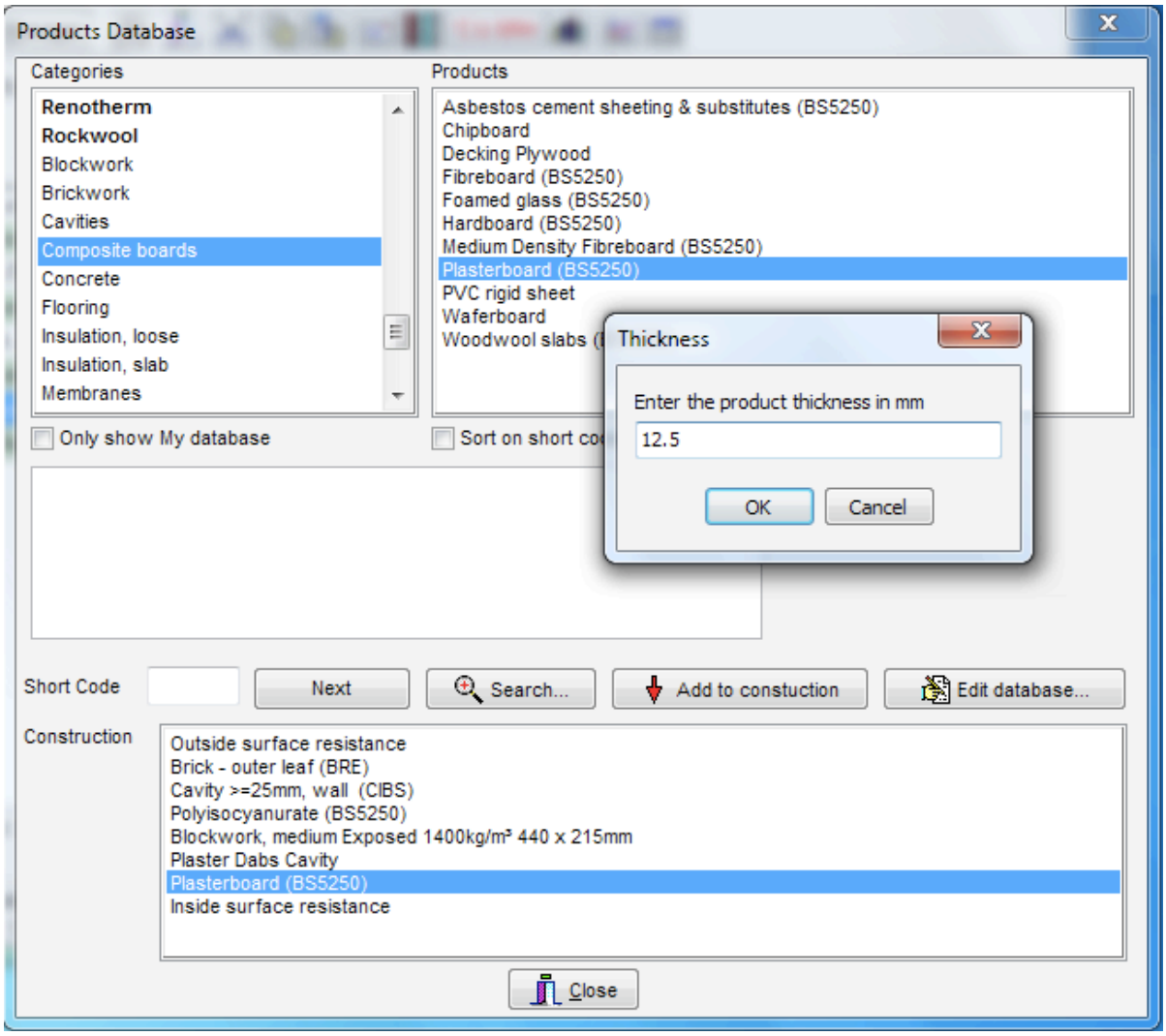


Figure 6.2: The Products Database window

The Products database contains a wide range of materials and cavities for use in U-value calculations and is accessed using the **Products Database** window (Figure 6.2). The window has three main parts:

- The **Categories** box, which is used to select the type of material you want to use. Categories of branded materials are shown in **bold**, categories of generic materials in normal text and user categories in *italics* (see chapter 13 for information on adding your own materials).
- The **Products** box, which you use to select a material from a particular category.

- The **Construction** box which shows the order of layers in the construction.

To insert layers using the Products Database:

1. In the layers list select the existing layer which will be *below* the new layer (see Figure 6.1).
2. On the **Insert** menu click **Layer from database** (or click the **Database** button on the toolbar). The **Products Database** dialogue opens.
3. Use the scroll bar on the **Categories** box to find the manufacturer or type of material you need, then click on that category. The **Products** box shows the material in that category.
4. Click on a material to select it, then click **Add to construction** (alternatively you can double click on the material in the **Products box**). The **Thickness** dialogue opens.

   *If the material has a set thickness the layer will be added without the **Thickness** dialogue opening.*
5. Enter the thickness of the layer then click **OK**. The **Construction** box now shows the new layer.
6. You can now add more layers from the database, using the **Construction** box to control the position of the new layers.
7. When you have finished adding layers click **Close**. The main **U-value** window now shows the calculation with the new layers added.

Product database hints

Product categories are sorted with branded materials first, followed by generic and user categories sorted in alphabetical order.
If you are not sure which category a particular material belongs to you can click **Search** to find it.
You can use the **Only show My database** box to make the software only show categories which you have added.

6.2 Inserting blank layers in a calculation

To insert a new blank layer:

1. Select the existing layer which will be *below* the new layer.
2. From the menu bar select **Insert**>**Blank layer** (alternatively you can press <Insert>). The new blank layer is added to the calculation *above* the existing layer.
3. Double click on the layer to open it for editing.

6.3 Managing layers

Once you have added layers to your calculation you change their order, cut, copy and paste them, or delete them.

- **Moving a layer**:
  - Click and hold the right-hand mouse button on the layer number at the left-hand side of the window.
  - Drag the layer to a new position.
  - Release the mouse button
- **Cutting a layer**: removes a layer from the calculation but keeps it available on the clipboard.
  - Click on the layer to select it.
  - Click the *Cut* button on the toolbar.
  - The layer is deleted from the calculation but remains on the clipboard for pasting.
- **Copying a layer**: puts a copy of the layer on the clipboard.
  - Click on the layer to select it.
  - Click the *Copy* button on the toolbar.
  - The layer remains in place but is copied to the clipboard.
- **Pasting a layer**: places the layer on the clipboard into the calculation.
  - Click on the layer which you want to be *below* the pasted layer.
  - Click the *Paste* button on the tool bar.
  - The layer on the clipboard is placed in the calculation *above* the selected layer.
- **Deleting a layer**: removes a layer permanently from the calculation.
  - Click on the layer to select it.
  - Click <Delete>.

7 Working with materials

The properties of layers are entered and edited in the **Edit Material** dialogue (Figure 7.1). The dialogue enables you to set:

- the basic characteristics of the material (section 7.1).
- the type of material (section 7.2).
- details of thermal bridging (section 7.4).
- any air gap correction (section 8.2).

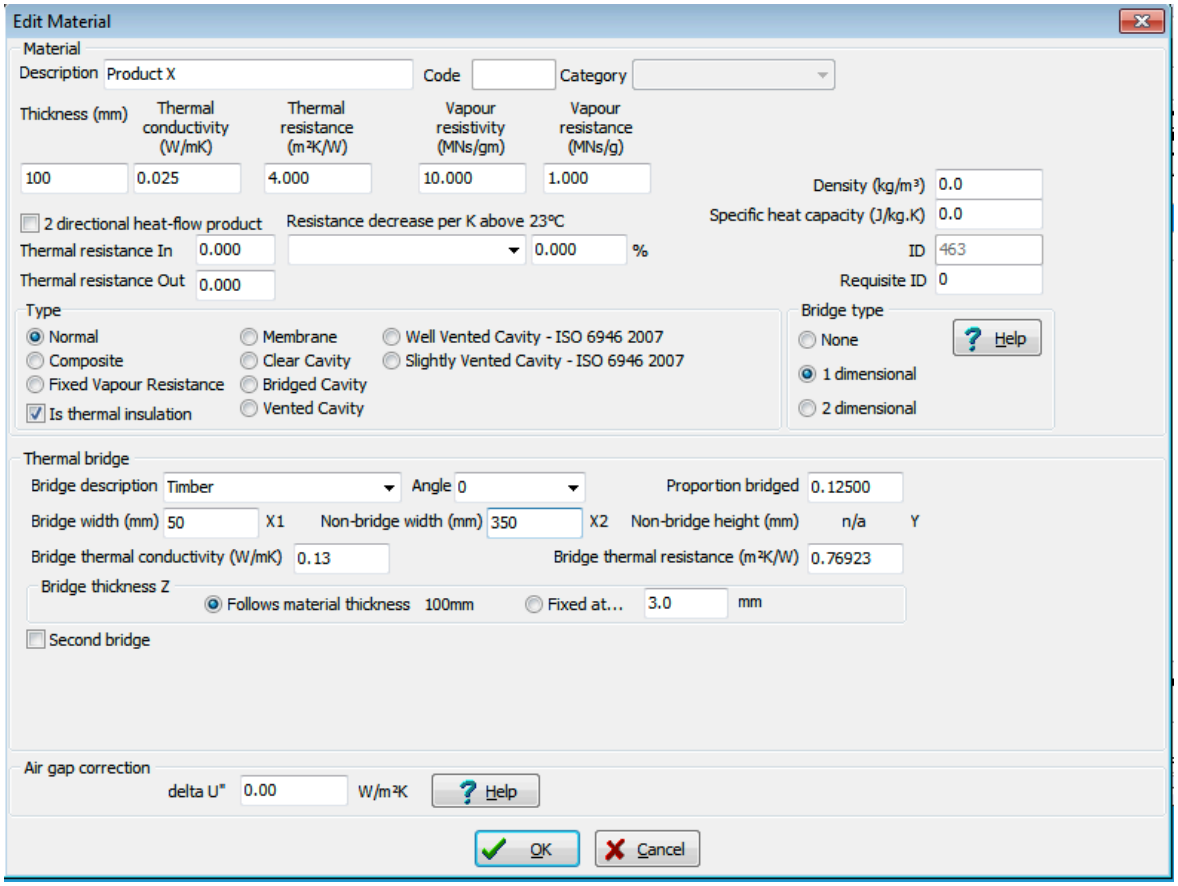


Figure 7.1: The Edit Material dialogue

To edit the properties of a layer:

1. Click on the layer to select.
2. From the menu bar select **Edit**>**Layer** (alternatively, double click the layer, or press <Enter>). The **Edit Material** dialogue opens.
3. Amend the data for the layer and click **OK**.

7.1 Basic characteristics

The **Material** section contains the basic data about the layer, including:

- **Description**: the name of the material or a description, which appears in the calculation.
- **Code** and **Category** : used with the database to sort or enter materials – but not in general use.
- **Thickness**: the cross-sectional thickness of the layer, measured in mm.
- **Thermal conductivity**: the rate of conduction heat transfer through 1m of the material, measured in W/mK. Usually referred to as the lambda value.
- **Thermal resistance**: the resistance to heat transfer provided by the layer, measured in m^2K/W.
- **Vapour resistivity**: the rate of transfer of water vapour through 1 m of the material, measured in MNs/gm.
- **Vapour resistance**: the resistance to water vapour provided by the layer, measured in MNs/g.

The following two values are only required for κ-value calculations.

- **Density**: the mass per cubic metre of the material, measured in kg/m^3.
- **Specific heat capacity**: the amount of energy required to raise the temperature of one kilogram of the material by one Kelvin (equivalent to 1 degree Celcius). kJ/kg.

The two-directional heat-flow settings are not used for calculations in the UK.

7.2 Types of material

Layers within building elements have different combinations of thermal and hygrothermal properties, which have to be address in U-value and condensation risk calculations. JPA Designer use four types of solid material and three types of cavity (see section 7.3). In addition, the program distinguishes between materials which are thermal insulation and those which are not. The rest of this section describes those types of layer and cavity, and the data required for each one.

Normal

Normal materials have the same composition all the way through, so the thermal resistance of a normal layer is calculated from the material's conductivity and thickness, and the vapour resistance is calculated from the thickness and vapour resistivity. A normal material requires the following information:

- **Type**: select *Normal*.
- **Description** : type a description of the layer – this will appear on the report.
- **Thickness**: enter in millimetres, mm.
- **Thermal conductivity**: enter in W/mK.
- The program calculates the **Thermal resistance** in m^2K/W.
- **Vapour resistivity**: (only required if you will be carrying out condensation risk analysis) enter in MNs/gm.
- The program calculates the **Vapour resistance** in MNs/g.

Composite materials

For composite materials, for example insulation-backed plasterboard, there is no direct link between the conductivity, thickness and thermal resistance. You must therefore use the thermal resistance for the specific configuration of the material (this will usually be supplied by the manufacturer of the product). The same principle applies to the vapour resistance.

A composite material requires the following information:

- **Type**: select *Composite*.
- **Description** : type a description of the layer – this will appear on the report.
- **Thickness**: enter in millimetres, mm.
- **Thermal resistance**: enter in m^2K/W.
- **Vapour resistance**: (only required if you will be carrying out condensation risk analysis) enter in MNs/g.

Fixed vapour resistance materials

Some materials – such as glass and metals – have vapour resistances which are effectively infinite, even if they are used in very thin layers. The *fixed vapour resistance* material type allows the thermal performance of these materials to behave in the same way as normal materials (changing according to the thickness), but allows their vapour resistances to be set as very high fixed values (typically 100.000 MNs/g.

As materials with fixed vapour resistances behave the same way as normal materials in thermal calculations you need only use the type in condensation risk calculations. A fixed vapour resistance material requires the following information:

- **Type**: select *Fixed vapour resistance*.
- **Description**: type a description of the layer – this will appear on the report.
- **Thickness**: enter in millimetres, mm.
- **Thermal conductivity**: enter in W/mK.
- The program calculates the **Thermal resistance** in m^2K/W.
- **Vapour resistance**: enter in MNs/g.

Membranes

Membranes, such as vapour control layers or vapour open roofing underlays, are treated as having no thermal resistance. The only property they have is their vapour resistance. Membranes require the following information:

- **Type**: select *Membrane*.
- **Description** : type a description of the layer – this will appear on the report.
- **Vapour resistance**: enter in MNs/g.

Membranes with low emissivity surfaces

Membranes have no direct effect on thermal calculations. However, a membrane which has one or two low emissivity faces may improve the thermal performance of a construction by increasing the resistance of adjacent cavities; that is addressed in the calculation by changing the resistance of the cavities, not the membrane.

Thermal insulation

The European product standards for factory manufactured thermal insulation[1] require the thermal resistance values of the applicable insulants be rounded down to the nearest $0.05\,m^2K/W$[2]. To comply with that requirement JPA Designer rounds down the thermal resistance of all layers which are marked at thermal insulation.

To mark a layer as thermal insulation tick the **is thermal insulation** box in the **Edit material** dialogue. The original value for thermal resistance will appear in the **Edit material** dialogue (e.g. $2.348\,m^2K/W$) while the **U-value** window will show the rounded value (e.g. $2.30\,m^2K/W$).

By default, rounding is **on**: this is indicated by red text in the status bar of the **U-value** window. However, as there may be occasions when you need to carry out calculations without rounding, the feature may be turned off and on:

[1] The series runs from BS EN 13162:2001 *Thermal insulation products for buildings. Factory made mineral wool (MW) products. Specification* to BS EN 13172:2001 *Thermal insulating products. Evaluation of conformity*. There is one standard for each major thermal insulation material

[2] The standards state: the value of thermal resistance, $R_{90/90}$, shall be …rounded downwards to the nearest $0.05\,m^2K/W$, and declared as R_D in levels with steps of $0.05\,m^2K/W$.

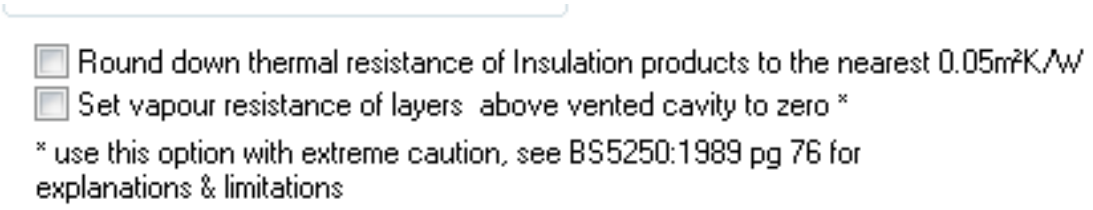

Round down thermal resistance of Insulation products to the nearest 0.05m²K/W
Set vapour resistance of layers above vented cavity to zero *
* use this option with extreme caution, see BS5250:1989 pg 76 for explanations & limitations

Figure 7.2: Controls for rounding of thermal resistance

1. On the **Project Manager** menu bar select **Options**.
2. Click on the **Other** tab.
3. (Figure 7.2).
4. Untick **Round down thermal resistance** to turn rounding off.

7.3 Types of cavity

JPA Designer recognises five types of cavity:

- clear cavities: cavities with limited air exchange with outside, and no thermal bridging.
- bridged cavities: cavities with limited air exchange with outside and which are thermally bridged.
- well vented cavities: cavities with substantial air exchange with outside.
- slightly vented cavities: cavities with some air exchange with outside.
- vented cavities: a type of well-vented cavity originally intended for use with condensation risk analysis. Not widely used.

Although the thermal resistance of a cavity can be calculated in JPA Designer (see section 7.3) it is usually entered as a default value appropriate for the direction of heat flow and the thickness range. The Product Database contains standard resistance values taken from BS EN ISO 6946.

Clear cavities

A clear cavity is an unvented cavity which has openings to outside of less than 500 mm^2/m. For example, a cavity in a cavity wall will be classified as an unvented cavity because the openings provided by the weep holes will be less than 500 mm^2/m limit.
Clear cavities require the following information.

- **Type**: select *Clear cavity*.
- **Description** : type a description of the layer – this will appear on the report.
- **Thickness**: enter in millimetres, mm.
- **Thermal resistance**: enter in m^2K/W.
- **Vapour resistance**: cavities have a vapour resistance of 0.00 MNs/g.

Bridged cavities

Bridged cavities, such as those in some timber framed constructions, are treated the same as unvented clear cavities, but with bridging details added (section 7.4). Bridged cavities require the following information.

- **Type**: select *Bridged cavity*.
- **Description** : type a description of the layer – this will appear on the report.
- **Thickness**: enter in millimetres, mm.
- **Thermal resistance**: enter in m^2K/W.
- **Vapour resistance**: cavities have a vapour resistance of 0.00 MNs/g.

You will also need to enter the bridging details (section 7.4).

If the width of the cavity is less than ten times its thickness you should use the **Airspace Resistance Calculator** to determine its thermal resistance (see section 7.3).

Well vented cavities

A well vented cavity has large ventilation openings between the cavity and the outside air, resulting in the conditions within the cavity being virtually the same as outside. A cavity is considered well vented if it has ventilation openings greater than 1500 mm^2/m (BS EN ISO6946): typically, the cavity behind rain-screen cladding will be well vented.

When well vented cavity is included in a calculation:

1. The thermal resistance of the cavity is set to zero.
2. The thermal resistances of all layers to the outside of the cavity are also set to zero.
3. The external surface resistance is set to match the internal surface resistance. This allows for the inner face of the cavity (which is effectively now the external face of the construction) being sheltering from the wind[3].

Well vented cavities require the following information:

- **Type**: select *Well vented cavity*.
- **Description** : type a description of the layer – this will appear on the report.

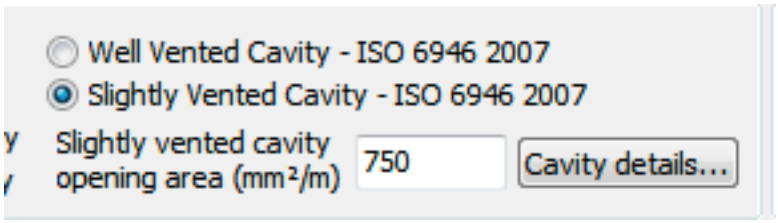

Well Vented Cavity - ISO 6946 2007
Slightly Vented Cavity - ISO 6946 2007
Slightly vented cavity opening area (mm²/m)
750
Cavity details...

Figure 7.3: Entering data for a slightly vented cavity

Slightly vented cavities

A slightly vented cavity has openings which are more than those of an unvented cavity but less than those of a well vented cavity (500–1500mm^2/m). As it is not possible to calculate the cavity resistance directly JPA Designer calculates the resistance of the construction with an unvented cavity and also with a well vented cavity then calculates a average resistance, weighted according to the area of openings (the procedure is described in ISO 6946:2007 section 5.3.3).

Slightly vented cavities require the following information:

- **Type**: select *Slightly vented cavity*.
- **Description** : type a description of the layer – this will appear on the report.
- **Slightly vented cavity opening area** mm^2/m: this is the area of openings in each linear metre of the cavity (see Figure 7.3).
- **Cavity details**: if the cavity has one or more low emissivity surfaces, or the width is less than ten times the thickness use the **Cavity details** button to open the **Airspace Resistance Calculator** (see section 7.3).

Vented cavities

A vented cavity is a special cavity type used in condensation risk analysis. When a cavity is defined as a vented cavity the vapour resistances of all layers to the outside of the cavity are set to zero. This is intended to model the effect of ventilation removing moisture from the cavity (for further information see section 17.4)[4]. Vented cavities require the following information:

- **Type**: select *Vented cavity*.
- **Description** : type a description of the layer – this will appear on the report.
- **Thickness**: enter in millimetres, mm.
- **Thermal resistance**: enter in m^{2}K/W.
- **Vapour resistance**: cavities have a vapour resistance of 0.00 MNs/g.

[3] If the inner face of the cavity is a low emissivity surface you will need to adjust the resistance to take account of that.

[4] The methodology was described in BS 5250:1989, but is not included in later versions of the standard: the vented cavity type is included mainly for backward compatibility.

Low emissivity cavities

A cavity which has one or more faces lined with a material with low surface emissivity will have a lower rate of heat transfer by radiation than a cavity with conventional, high emissivity faces. Including such a 'low emissivity cavity' within a construction will reduce the overall rate of heat loss through the construction, in some cases by as much as 10%.

There are several types of material with low emissivity surfaces:

- insulation boards with reflective surfaces, such polyisocyanurate boards;
- plastic films with aluminium foil facing;
- membranes with metalised faces;
- 'multi-foil' insulants.

To be effective, each low emissivity surface must face a cavity, at least 25 mm wide.

Although the U-value calculation methods implemented in JPA Designer cannot directly assess the effect of reducing radiation heat loss, it is possible to account for the effect of such materials by adjusting the thermal resistance of a cavity which has a low emissivity material to one or more faces.

The thermal resistance value for a low emissivity cavity must be obtained by a valid test method, which considers only the effect of the material upon the overall conduction heat losses through an element. Values should have third party certification, such as in BBA Agrément certificates. If you are not supplied with certified values, use the default value for a low emissivity cavity of 0.44 m^2K/W for walls, 0.34 m^2K/W for roofs and 0.50 m^2K/W for floors (see BR 443 paragraph 4.8.2). If you know the emissivity of the facing material you can also use the **Airspace Resistance Calculator** (section 7.3) to calculate the resistance.

Calculating cavity resistances

The default resistances for cavities are not valid for cavities with one or more low emissivity surfaces, or those with a width which is less than ten times the thickness. You should therefore use the **Airspace Resistance Calculator** to calculate the correct resistance.

To calculate an airspace resistance:

1. Set the **Type** of layer to *Clear Cavity* or *Bridged Cavity*. The **Airspace Resistance Calculator** button appears beside the thermal resistance (see square 1 in Figure 7.4).
2. Click the button. The **Airspace Resistance Calculator** is displayed (Figure 7.4).
3. Set:
    - **Air space thickness**, **d**, in mm. This is measured in the direction of heat flow.
    - **Airspace width**, **b**, in mm. This is the width measured at right angles to the heat flow. For a wide cavity, such as that in a cavity wall enter a value at least ten times greater than the thickness.

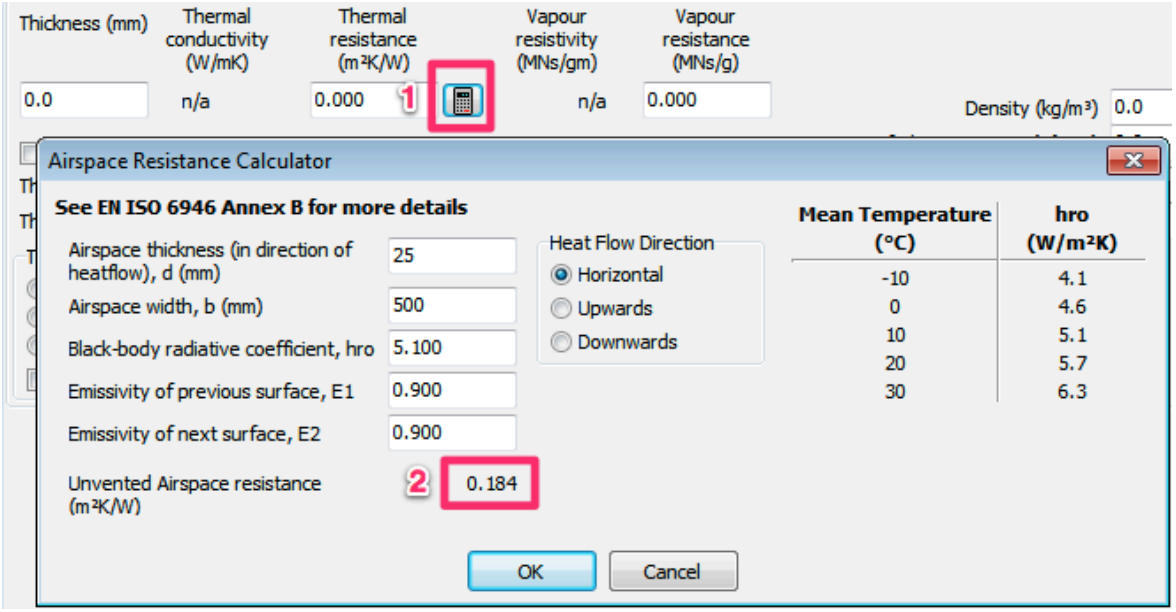


Figure 7.4: The Airspace Resistance Calculator: 1 shows the button on the Edit material dialogue; 2 shows the calculated resistance.

- **Black-body radiative coefficient**, **hr0**, in W/m^{2}K. Take the value from the table on the right, for the mean temperature. For the UK a mean temperature of 10ºC is usually appropriate.
- The **emissivities** of the two surfaces of the cavity. Most materials have an emissivity around 0.90, but foil facings to insulation, and metalised membranes have much lower emissivities, typically 0.03–0.05.
- The heat flow direction.

4. The program now displays the resistance for the airspace (see square 2 in Figure 7.4).
5. Click **OK**. The calculated resistance is transferred to the **Thermal resistance** box of the **Edit Material** dialogue.

7.4 Thermal bridging

Thermal bridges are formed where the material in a layer is interrupted by a second material with different thermal conductivity, for example, insulation in a timber framed wall being interrupted (bridged) by the timber studs. In most cases thermal bridging increases heat loss through the bridged layer[5]. The effect of thermal bridges which occur regularly throughout a layer (repeating thermal bridges) is included in U-value calculations by added the details of the thermal bridge to each bridged layer using the **Edit material** dialogue.

JPA Designer offers three different methods of entering thermal bridging:

- Using one of the built-in defaults to set the bridging fraction and material;

[5]Hence the commonly used term 'cold bridge'. However, mortar in stone walls will usually reduce the rate of heat loss.

- Setting the bridging fraction and bridging material directly;
- Entering the bridging dimensions and material.

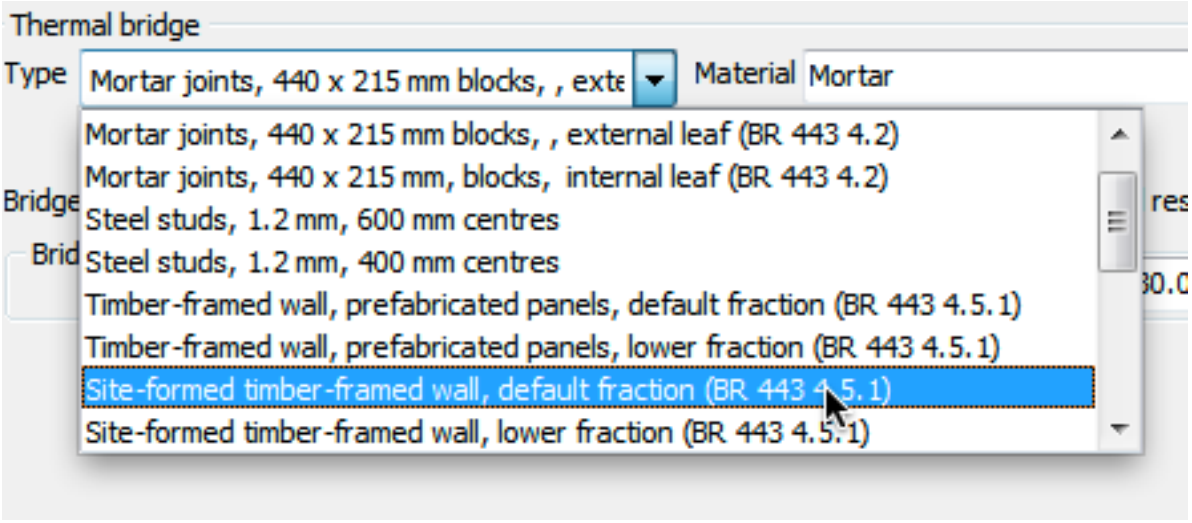

Thermal bridge
Type
Mortar joints, 440 x 215 mm blocks, , exte
Material
Mortar
Mortar joints, 440 x 215 mm blocks, , external leaf (BR 443 4.2)
Mortar joints, 440 x 215 mm, blocks, internal leaf (BR 443 4.2)
Steel studs, 1.2 mm, 600 mm centres
Steel studs, 1.2 mm, 400 mm centres
Timber-framed wall, prefabricated panels, default fraction (BR 443 4.5.1)
Timber-framed wall, prefabricated panels, lower fraction (BR 443 4.5.1)
Site-formed timber-framed wall, default fraction (BR 443 4.5.1)
Site-formed timber-framed wall, lower fraction (BR 443 4.5.1)

Figure 7.5: Using one of the default thermal bridging conditions

To use a default thermal bridge:

1. Set the **Bridge type** to *1 dimensional*.
2. From the Thermal bridge **Type** list select one of the default bridging conditions ({}(#tbdefault)).
3. The program sets:
   - The bridge material;
   - The thermal conductivity of the bridge;
   - The fractional area of the bridge (referred to in JPA Designer as the *Proportion bridged*).

The default conditions are listed in Table 7.1.

To set the bridging material and proportion directly:

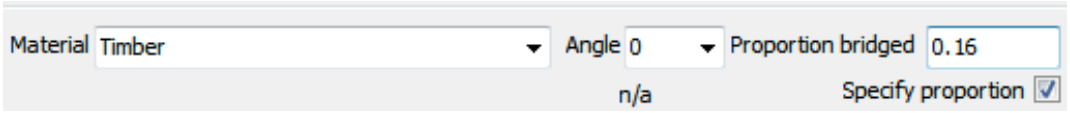


Figure 7.6: Setting the bridging proportion directly

1. Select the bridging **Material** (which sets the thermal conductivity of the bridge).
2. Tick the box **Specify proportion** (Figure 7.6).

Table 7.1: Default bridging fractions

Construction	Material	Conductivity	Fraction
Mortar joints, 440 x 215 mm blocks, , external leaf (BR 443 4.2)	Mortar	0.94	0.067
Mortar joints, 440 x 215 mm, blocks, internal leaf (BR 443 4.2)	Mortar	0.88	0.067
Steel studs, 1.2 mm, 600 mm centres	Steel	50	0.002
Steel studs, 1.2 mm, 400 mm centres	Steel	50	0.003
Timber-framed wall, prefabricated panels, default fraction (BR 443 4.5.1)	Prefab panels	0.12	0.150
Timber-framed wall, prefabricated panels, lower fraction (BR 443 4.5.1)	Prefab panels	0.12	0.125
Site-formed timber-framed wall, default fraction (BR 443 4.5.1)	Softwood	0.13	0.150
Site-formed timber-framed wall, lower fraction (BR 443 4.5.1)	Softwood	0.13	0.125
Ceiling, trussed rafters 35 mm, 600 mm cc + 1% other timbers (BR 443 4.6.1)	Softwood	0.13	0.068
Ceiling, 50 mm joists, 400 mm cc + 1% other timbers (BR 443 4.6.1)	Softwood	0.13	0.135
Ceiling, default: 48 mm, 600 mm cc + 1% other timbers (BR 443 4.6.1)	Softwood	0.13	0.090
Timber floor, default: 38 mm, 400 mm cc + 1% other timbers (BR 443 4.6.2)	Softwood	0.13	0.110
Plasterboard battens, 47 mm, 600 mm cc + rails (BR 443 4.7.2)	Softwood	0.13	0.118
I-beam flanges, 38 mm wide, default fraction (BR 443 4.5.2)	Softwood	0.13	0.150
I-beam flanges, 38 mm wide, lower fraction (BR 443 4.5.2)	Softwood	0.13	0.125
I-beam flanges, 48 mm wide, default fraction (BR 443 4.5.2)	Softwood	0.13	0.170
I-beam flanges, 48 mm wide, lower fraction (BR 443 4.5.2)	Softwood	0.13	0.145
I-beam web, 4 to 8 mm (BR 443 4.5.2)	OSB	0.13	0.040

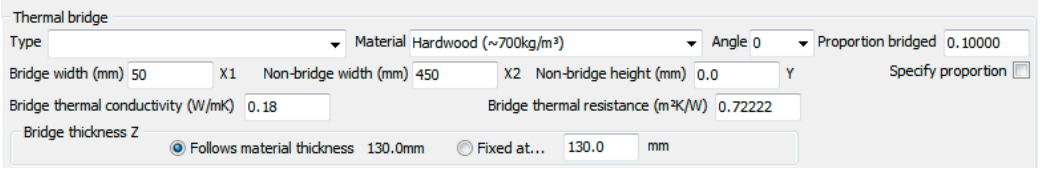


Figure 7.7: Entering thermal bridging using dimensions

3. Enter the **Proportion bridged**.

To enter thermal bridging details using dimensions:

1. Use the **Bridge type** radio buttons to determine whether the bridging is *1 dimensional* or *2 dimensional*:

   - one-dimensional e.g. timbers running in one direction; or,
   - two-dimensional e.g. mortar joints which run vertically and vertically. *If you are not sure whether the bridging is one or two dimensional clicking the **Help** button will open a guidance window: the annotation on the help diagrams match those on the data entry boxes.*

2. In the **Thermal bridge** section of the dialogue (Figure 7.7) select the bridging material from the **Material** drop-down. The program sets the **Bridge thermal conductivity**.

   If you are using an unusual bridging material you can enter your own description, then enter the conductivity manually.

3. Enter the **Bridge width** in mm.
4. Enter the **Non-bridge width** in mm.
5. For two-dimensional bridging enter the **Non-bridge height** in mm.
6. Set the bridge thickness by selecting **Follows material thickness**, or selecting **Fixed at** then entering thickness in mm.

In some constructions – notably built up metal roof and wall cladding – there are two sets of thermal bridges. To enter details of a second bridge:

1. Enter the details for the first bridge.
2. Click the **Second bridge** box. The **Optional second bridge** section is displayed.
3. Select the bridging material from the **Bridge description** drop-down. The program sets the **Bridge thermal conductivity**.

If you are using an unusual bridging material you can enter your own description, then enter the conductivity manually.

1. Enter the **Bridge width** in mm. The software uses the **Non-bridge width** for the first bridge to calculate the **Proportion bridged**.

   Non-bridge width = centre-to-centre distance - (bridge 1 + bridge 2).

2. When the bridging material is air you can use the **Small airspace resistance** button to calculate the thermal resistance of the bridge: enter the thickness of the airspace and its width – both in mm – then click **OK**. The resistance is displayed in the **Bridge thermal resistance** box.

8 Correction factors and adjustments

The rate of heat loss through an element can be affected by number of other conditions, which can be addressed in the U-value calculation by applying correction factors. There are correction factors for:

- Mechanical fasteners which penetrate insulation, *dUf* (section 8.1);
- Air gaps in insulation layers, *dUg* (section 8.2).
- The effect of rainwater cooling on inverted roofs, *dUr* (section 8.3;
- Insulation compression in built up metal roofing and cladding, *dUp* (section 9.2).

The correction factors are calculated separately from thermal resistances of the layers. The correction factors are added to the raw U-value, unless their total is less than 3% of the raw U-value (in which case they are ignored). The values for correction factors are displayed in the main U-value window, next to the final U-value.

U-value calculations should also be adjusted for:

- The effect of having an unheated space to the cold side of the construction (section 8.5).
- Brackets in rainscreen cladding systems (section 8.4).

8.1 Mechanical fasteners

Metal fasteners which penetrate layers of thermal insulation reduce the effectiveness of the insulation: that effect has to be included in U-value calculations, using the correction factor *dUf*. Common constructions which require the correction are:

- Cavity walls with partial or full-fill cavity insulation.
- Warm pitched roofs where insulation is laid over the rafters and restrained by counterbattens fixed back to the rafters.
- Warm flat roofs where the insulation and/or the waterproof membrane is mechanically fixed to the deck.

There is no need to apply a correction:

- to constructions without fasteners, e.g. solid masonry walls;
- for fasteners with both ends in contact with metal sheets;
- for wall ties across an empty cavity;
- for wall ties between a masonry leaf and timber studs;
- where the thermal conductivity of the fastener, or part of it, is less than 1W/mK (such as plastic ties).

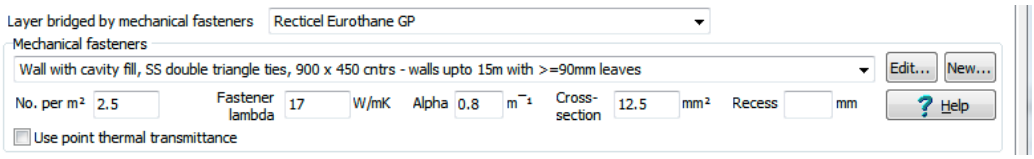


Figure 8.1: Data entry boxes for the mechanical fasteners correction

There are two methods for calculating the effect of mechanical fasteners:

- using a point thermal transmittance value;
- calculating the correction based on the fastener dimension and materials[1].

Correcting using a point thermal transmittance

The point thermal transmittance is a measure of the additional heat loss resulting from a fixing or bracket. A value quoted for a particular fixing is valid only for that fixing.

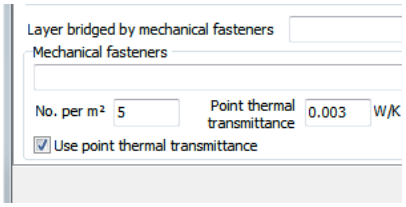


Figure 8.2: Entering details of the point thermal transmittance

To use a point thermal transmittance:

1. On the **Edit** menu click **Construction type**.
2. Click **Use point thermal transmittance** (Figure 8.2).
3. Enter the **Number of fasteners per** m^2.
4. Enter the **Point thermal transmittance**.

[1] All versions of JPA Designer from 4.04b1 build 025 onward use the method in BS EN ISO 6946:2007. It is possible to use the method in BS EN ISO 6946:1997 by unpicking the **Mechanical fasteners** box on the **Other** tab of the **Options** dialogue, but there is little reason to do so.

Correcting using fastener data

If the point thermal transmittance of the fastener is not known the additional heat loss resulting from the fasteners can be calculated (Figure 8.1):

1. On the **Edit** menu click **Construction type**.
2. In the **Layer bridged by mechanical fasteners** list select the layer which the fasteners penetrate.
3. Enter the **number of fasteners per square metre**.
4. Enter the **Fastener lambda**: that is the thermal conductivity of the fastener. Typically this will be 17 W/mK for stainless steel and 50 W/mK for mild steel.
5. Enter the **alpha coefficient** which is 0.8 for the standard case of a non-recessed fastener.
6. Enter the **cross sectional area of the fastener**: typical double triangle ties have a cross sectional area of 11.3 mm^2 (based on 3.8 mm diameter).

Alternatively you can select a standard fastener configuration from the **Mechanical fasteners** list.

If the fastener does not penetrate the whole insulation layer – for example because a mushroom cap is being used – enter the depth of insulation*without* a fastener as the **Recess**.

Saving fastener configurations

If you frequently use a configuration of fasteners which is not in the **Mechanical fasteners** you can add a new configuration to the list or edit an existing one.

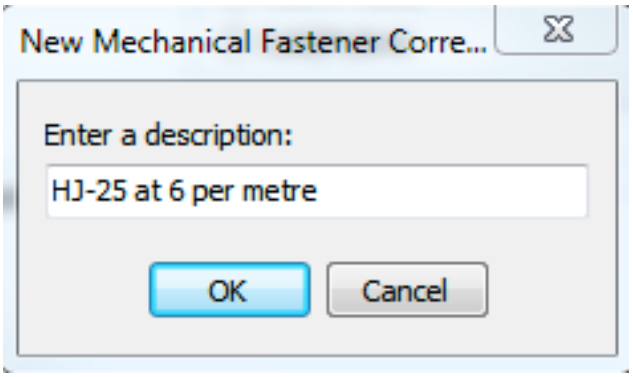


Figure 8.3: Naming a new mechanical fasteners configuration

To create a new configuration:

1. In the **U-value construction** dialogue click **New**.
2. In the **New Mechanical Fastener Correction** dialogue enter a description of the configuration (Figure 8.3). This is the description which will appear in the **Mechanical fasteners** list.

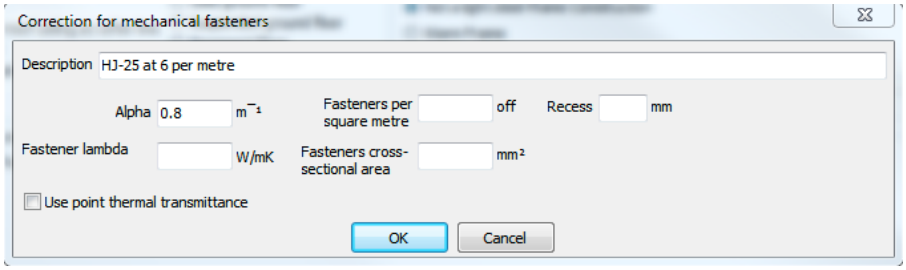


Figure 8.4: Defining a new default configuration for mechanical fasteners

3. In the **Correction for mechanical fasteners** dialogue (Figure 8.4) enter:
   - **Fasteners per square metre**.
   - Any **recess** figure.
   - **Fastener lambda** – the thermal conductivity of the fastener.
   - The **Fastener cross-sectional area**.
   - **Alpha** should be 0.8, except for cold or hybrid light steel framed constructions when it should be 1.6.
4. If you are using a point thermal transmittance tick the box then enter the **transmittance** and number of **fasteners per square metre**.

You can also edit an existing configuration:

1. In the **U-value construction** dialogue select an item in the **Mechanical fasteners** list.
2. Click **Edit**.
3. In the **Correction for mechanical fasteners** dialogue edit the values to match your requirements.

8.2 Air gap correction

Air movement through and around an insulation layer will reduce its thermal performance. The effect of that reduction is included in the U-value calculation by a correction factor, *dUg*, which is derived from the relative thermal resistances of the insulation layer and the construction as a whole, and from a coefficient *dU″*, which represents the size of gaps in the insulation layer. Values for *dU″* are:

- Where no air gaps penetrate the insulation layer and no air circulation is possible on its warm side, $dU'' = 0.00\ W/m^2K$.
- Where some air gaps penetrate the insulation layer and no air circulation is possible on its warm side, $dU'' = 0.01\ W/m^2K$.
- Where some air gaps penetrate the insulation layer and some air circulation is possible on its warm side, $dU'' = 0.04\ W/m^2K$.

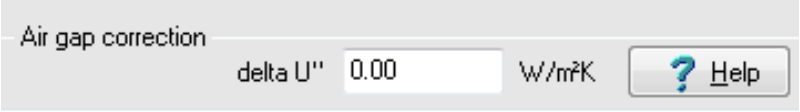


Figure 8.5: Correcting for air gaps in insulation layers

A value for *dU″* must be set for *every* insulation layer.
To correct for air gaps:

1. In the main U-value window double click on the insulation layer. The **Edit material** dialogue opens.
2. Enter the appropriate value for *dU″* in the **dU″** box (see Figure 8.5). then click **OK**.

   *Click the **Help** button to view the standard values for dU″. In many cases the default value of zero is appropriate.*

8.3 Rainwater cooling

Inverted roofs – or protected membrane roofs – have some or all of the thermal insulation installed over the top of the waterproof membrane where it is restrained by aggregate or other ballast. Rainwater falling on inverted roofs can percolate between insulation boards to the waterproofing membrane, where it will increase the rate of heat loss. The reduction in performance is represented within a U-value calculation by the rainwater cooling correction factor, *dUr*, which is calculated from:

- The average rate of rainfall during the heating season, *p* (mm/day);
- A drainage factor, *f*, which represents the fraction of *p* which reaches the waterproofing membrane;
- A factor for increased heat loss caused by rainwater flowing on the membrane, *x* (Wday/m^{2}Kmm).

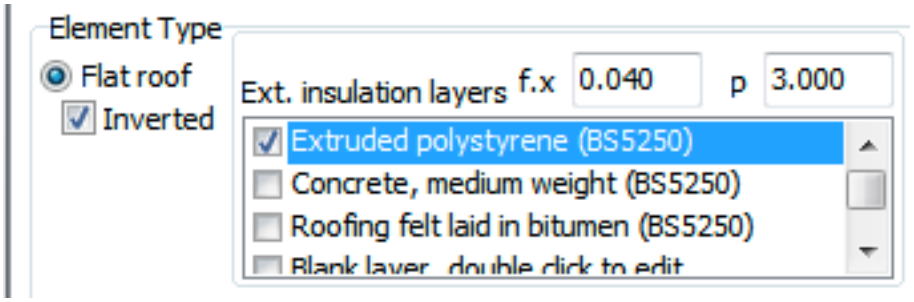


Figure 8.6: Setting the rainwater cooling correction for an inverted roof

In JPA Designer the data is entered using the **U-value Construction** dialogue Figure 8.6). As you have to indicate which layer is affected by the rainwater cooling it is best to add the correction factor *after* you have defined the layers in the construction.
To enter rainwater cooling data:

1. From the menu bar select **Edit**>**Construction Type**.
2. In the **Element type** section select *Flat roof*.
3. Tick the **Inverted roof** box.
4. In the **External insulation layers** box tick the layer(s) is affected by the rainwater cooling.

Where a low U-value is required there may be more than one insulation layer affected.

1. Enter values for *f.x* and *p*. Click **OK**.

If you do not have project-specific values you can use the default values for f.x and p.

8.4 Rainscreen cladding

When calculating U-values for walls which include rainscreen cladding the results have to be adjusted to account for the effect of fixing brackets which support the cladding and, in doing so, penetrate the insulation. JPA Designer can correct for the effect of point fixings, using method (c) in section 4.9.5 of BR 443 *Conventions for U-value calculations*.

The calculation requires the point thermal transmittance of the fixing, **x**, and the number of fixings per square metre, **n**. As **x** depends on the type of fixing you must get the correct value from the fixing manufacturer. The data is entered in the **U-value Construction** dialogue.

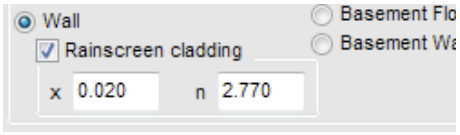


Figure 8.7: Data for rainscreen cladding correction

To correct for brackets in rainscreen cladding:

1. From the menu bar select **Edit**>**Construction Type**.
2. In **Element type** select *Wall*.
3. Tick the **Rainscreen cladding** box.
4. Enter values for **x** and **n** (see Figure 8.7).

   If you do not have project-specific values you can carry out an initial calculation using the default values for x and n.

8.5 Elements separating heated and unheated spaces

The rate of heat loss through an element which separates a heated space from an unheated space will be lower than that through an identical element which separates a heated space from outside, as the relatively warm air within an unheated space acts as a thermal buffer.

The combined method for calculating U-values allows for this effect by assigning a thermal resistance to the unheated space. The resistance is based on:

- the surface areas of the elements which separate the heated space from the unheated space, *Ai*, measured in m^2;
- the surface areas and U-values of the elements which separate the unheated space from outside, *Ae*, measured in $m^2$and *Ue*, measured in W/m^2K;
- The volume of the unheated space, *V*, measured in m^3;
- The ventilation rate, *n*, measured in air changes per hour (ach).

When measuring *Ai* and *Ae*, you should include walls and intermediate floors (such as that over an integral garage) but exclude ground floors.

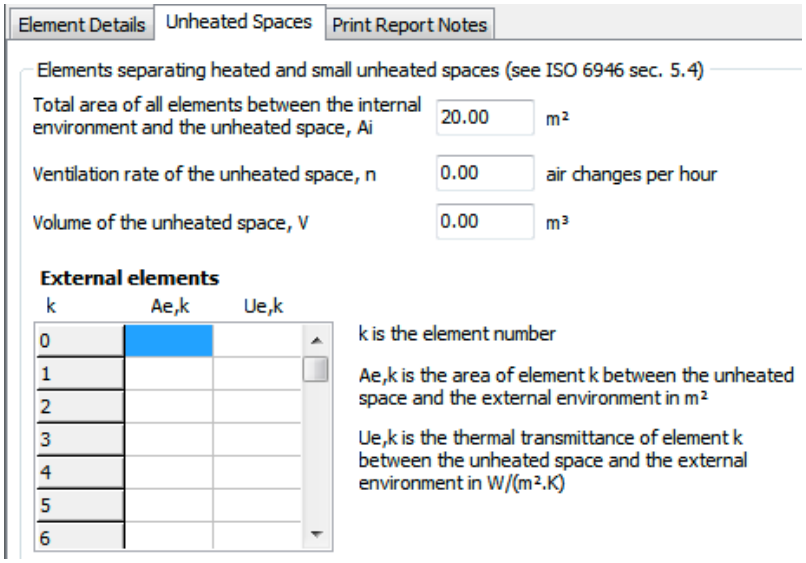

Element Details
Unheated Spaces
Print Report Notes
Elements separating heated and small unheated spaces (see ISO 6946 sec. 5.4)
Total area of all elements between the internal environment and the unheated space, Ai
20.00
m²
Ventilation rate of the unheated space, n
0.00
air changes per hour
Volume of the unheated space, V
0.00
m³
External elements
k
Ae,k
Ue,k
0
1
2
3
4
5
6
k is the element number
Ae,k is the area of element k between the unheated space and the external environment in m²
Ue,k is the thermal transmittance of element k between the unheated space and the external environment in W/(m².K)

Figure 8.8: Data entry for elements separating heated and unheated spaces

To allow for unheated spaces:

1. In the **U-value Construction** dialogue click on the **Unheated Spaces** tab (Figure 8.8).
2. Enter:
   - The area, **Ai** ;
   - The ventilation rate, **n**; *Use a ventilation rate of 3 ach if the actual ach is not known.*
   - The volume of the unheated space, **V**.

3. For each of the elements separating the unheated space from outside enter:

    - The area, *Ae,k*;
    - The U-value, *Ue,k*.

    Ue,k can be calculated in a separate calculation in JPA Designer. Use a value of 2 W/m^{2}K *if the details of the element is not known.*

Using the pre–2007 method

The 1997 edition of BS EN ISO 6946 included a different method to calculate the resistance of an unheated space. It is possible to use the older method in JPA Designer:

1. In the **Edit Construction** dialogue select the **Unheated spaces** tab.
2. Tick **Use BS 6946 pre–2007 method**.
3. In the **Ai** box enter the total area of all elements separating the internal environment from the unheated space.
4. In the **Ae for BS 6946 Pre 2007 method** box enter the total area of all elements separating the unheated space from outside.

9 Advanced calculations

9.1 Light steel framed structure

The high thermal conductivity of steel means the combined method must be modified for elements where some or all of the insulation is bridged by light steel framing. JPA Designer uses the modified calculation method which was published in BRE Digest 465. *U-values for light steel-frame construction*.

There are three different forms of light steel-framed structures:

- *Warm* frame constructions: all the insulation is outside the steel framing.
- *Hybrid* constructions: some insulation is fitted between the steel studs and additional insulation placed on the outside of the studs to reduce thermal bridging through the steel.
- *Cold* frame constructions: all of the insulation is included within the thickness of the steel components and is bridged by it.

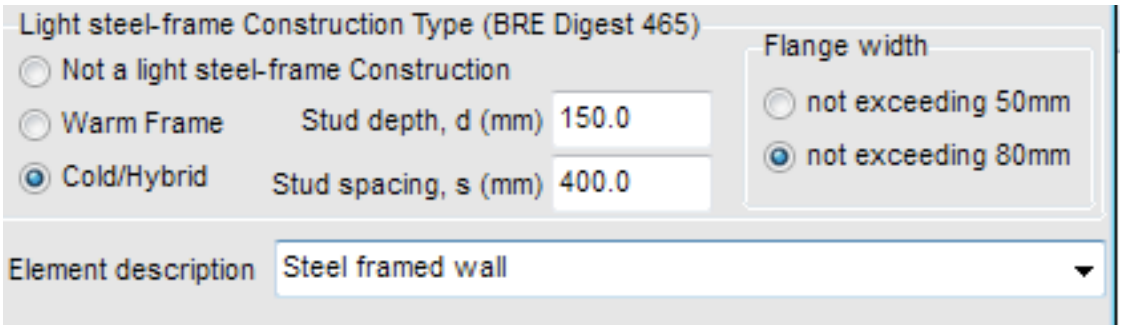


Figure 9.1: Setting the type and details of light steel frame construction

The procedure for calculating the U-value of a light steel-framed element using JPA Designer is the same as for any other element, but with the following modifications:

1. Identify the element as light steel-framed and enter the framing details (Figure 9.1).
    - In the **Uvalue Construction** dialogue use the *light steel-frame* radio buttons to define is as **warm** or **cold/hybrid**.

- For a **Cold** or **Hybrid** construction enter the **stud spacing**, **stud depth** and **flange width**. Use the offered default values if you do not know the stud depth and spacing.

2. Enter the layers of the construction in the main **Uvalue** window.

   - For *cold* and *hybrid* elements some of the layers will be bridged by steel: see section 7.4 for guidance on entering bridged layers. Any airspace behind the insulation and between the studs should be entered as a bridged cavity. (Do not include the flanges of the steel studs when entering bridging details.)
   - In *warm* elements the air space between the studs should be entered as a bridged cavity, with steel as the bridging material.

3. Enter corrections for any mechanical fasteners which penetrate the insulation by completing the **Correction for mechanical fasteners** section in the **Uvalue Construction** dialogue (section 8.1).

   Use the first drop box to indicate which layer is bridged by the mechanical fasteners, then enter the fasteners' dimensions and spacing. The **alpha coefficient** is 0.8 for warm constructions and 1.6 for cold/hybrid constructions.

9.2 Twin skin metal cladding and roofing

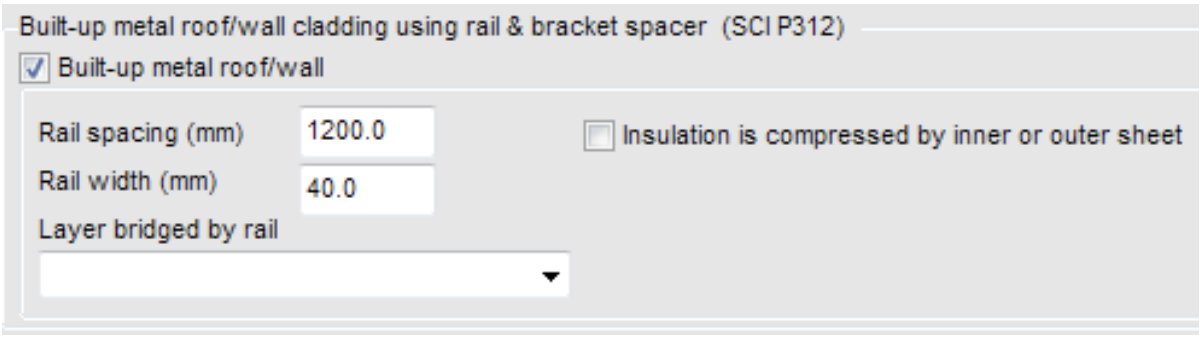

Built-up metal roof/wall cladding using rail & bracket spacer (SCI P312)
Built-up metal roof/wall
Rail spacing (mm)
1200.0
Rail width (mm)
40.0
Layer bridged by rail
Insulation is compressed by inner or outer sheet

Figure 9.2: Built-up metal wall or roof cladding

The additional heat loss resulting from thermal bridging in twin-skin metal roofing and cladding systems formed with rails and brackets requires a modification to the standard combined method. JPA Designer uses the method described in the Steel Construction Institute research paper SCI P312, which takes account of:

- The bridging effects of the rail and the air spaces around the rail.
- The point bridging produced by the brackets.
- The compression of the insulation by a shallow-profiled liner (profile depth less than 25 mm).

To calculate U-values for twin-skin metal roofing or cladding:

1. Create and open a new U-value calculation.
2. Enter any project information.
3. In the **U-value Construction** dialogue select either *wall* or *flat roof*. Do not tick the **Built up metal roof/wall** box at this stage. Click **OK**.
4. Enter the layers in the construction in the main **U-value** window. Enter the insulation in *two layers*: the uppermost layer being the insulation which is bridged by the rails and the underneath that which is penetrated only by the brackets.

   For example, a 170 mm layer of insulation in a construction with 40 mm deep rails should be divided into one layer 40 mm thick and one layer 130 mm thick. You will find later parts of the calculation easier if you give the two layers distinctive names.
5. Enter the bridging details for the layer of insulation bridged by the rails (section 7.4 for details). In the **Edit Materials** dialogue select *one dimensional bridging* to show the thermal bridging details. Enter the details of the rails: **bridge material – steel studs, bridge width, non-bridge width**. The software sets the bridge thermal conductivity. The program will show the proportion bridged and the thermal resistance of the bridge.

   *For 'L' shaped sections the **bridge width** will usually be the thickness of the steel, but for 'C' and 'U' sections, where the rail penetrates the insulation layer twice, use double the thickness of the steel as the bridge width.*
6. Enter the bridge details for the air spaces caused by the rail. Tick the **Second bridge** box. The **Optional second bridge** section is displayed.
7. Enter the **bridge material** (air) and **bridge width** (in mm): use twice the rail width to allow for the compression of the insulation around the rails.

   The program calculates the proportion bridged using the data from the first bridge, so the non-bridged width = (Centre-to-centre distance of rails) - (bridge thickness 1 + bridge thickness 2).
8. To calculate the thermal resistance of the air space click the **Small airspace resistance** button. The **Airspace Resistance Calculator** dialogue opens (see Figure 7.4).
9. Enter the **thickness** and **width** of the air space. The thickness will be the same as the rail depth. The width should be twice the rail thickness. Leave the emisivity values at 0.9.
10. Enter the air gap correction, dU″, for *both* insulation layers (section 8.2): use the value 0.01. Click **OK**.
11. From the menu bar select **Edit**>**Construction Type**.
12. In the **U-value Construction** dialogue tick **Built up metal roof/wall**.
13. In the **Built-up metal roof/wall cladding** section enter the **Rail spacing** and **Rail width** (Figure 9.2). Use the drop-down to select the **Layer bridged by rail**.
14. If the liner profile compresses the insulation and the depth of the profile is 25 mm or less tick the box **Insulation is compressed by inner or outer sheet**. Four new data boxes appear.

15. Enter the **Sheet profile width**, **Sheet profile depth** and **Sheet profile centres** in mm. In the drop box select the layer of insulation which is *not* bridged by the rails.

    If the liner profile is deeper than 25 mm ignore the check box and change the thickness of the insulation layer by subtracting the profile depth from the original thickness (e.g. for a 30 mm profile with 130 mm actual depth of insulation use a value of 100 mm).

16. Enter the details for the brackets in the **Correction for mechanical fasteners** section. Enter:

    - The **thermal conductivity of the brackets** (usually 50.00 W/mK for mild steel);
    - The **number of brackets per square metre** (calculated by dividing the total number of brackets by the total element area)
    - The **cross sectional area of the brackets** (measured at the thickest point).
    - The value of **alpha**, 1.6, is the default setting for these constructions.

17. Select the **Layer bridged by brackets**.

9.3 Inverted roofs

In inverted roofs (often known as protected membrane roofs) some or all of the thermal insulation is applied above the waterproof membrane and restrained by aggregate or other ballast. Rainwater falling on the roof can percolate to the waterproofing membrane and increase the rate of heat loss. To allow for that a rainwater cooling correction factor, *dUr*, has to be applied to inverted roof calculations (the rainwater cooling factor is described in section 8.3).
As the correction factor requires you to select the layers affected by rainwater cooling it is best to add the correction factor *after* you have defined the layers in the construction.

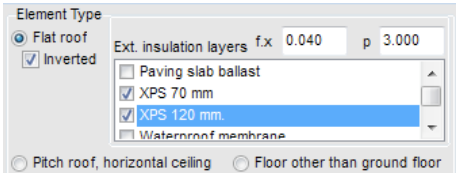


Figure 9.3: Inputting data for rainwater correction

To enter an inverted roof:

1. From the file menu select **Edit**>**Construction type**. The **U-value Construction** dialogue opens.
2. In **Element type** select *Flat roof*. Insert an **Element description** then click **OK**.
3. Add the layers of the construction (chapter 6).
4. Open the **U-value construction** dialogue again and in **Element Type** tick the **Inverted** box. The dialogue shows three data boxes (Figure 9.3).
5. Enter the values for **f.x** and **p** and in the box select the layers of insulation above the waterproof membrane. Click **OK**.

9.4 Using variable layers

The variable layer feature of JPA Designer helps you compare the performance of different materials in a construction, or of different thicknesses of the same material.

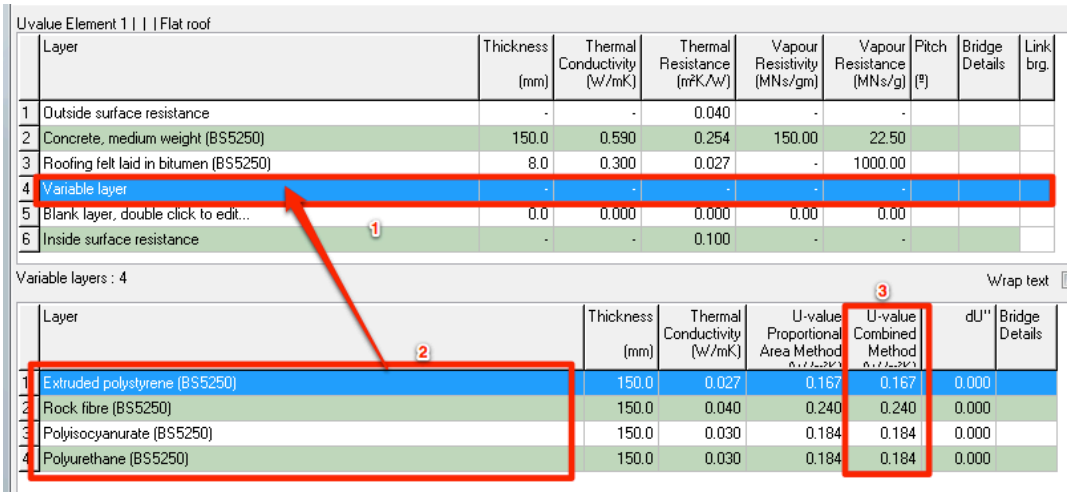

Uvalue Element 1 | | | Flat roof
Layer
Thickness (mm)
Thermal Conductivity (W/mK)
Thermal Resistance (m²K/W)
Vapour Resistivity (MNs/gm)
Vapour Resistance (MNs/g)
Pitch (º)
Bridge Details
Link brg.
1 Outside surface resistance - - 0.040 - -
2 Concrete, medium weight (BS5250) 150.0 0.590 0.254 150.00 22.50
3 Roofing felt laid in bitumen (BS5250) 8.0 0.300 0.027 - 1000.00
4 Variable layer - - - - -
5 Blank layer, double click to edit... 0.0 0.000 0.000 0.00 0.00
6 Inside surface resistance - - 0.100 - -
1
Variable layers : 4
Wrap text
3
Layer
Thickness (mm)
Thermal Conductivity (W/mK)
U-value Proportional Area Method
U-value Combined Method
dU''
Bridge Details
2
1 Extruded polystyrene (BS5250) 150.0 0.027 0.167 0.167 0.000
2 Rock fibre (BS5250) 150.0 0.040 0.240 0.240 0.000
3 Polyisocyanurate (BS5250) 150.0 0.030 0.184 0.184 0.000
4 Polyurethane (BS5250) 150.0 0.030 0.184 0.184 0.000

Figure 9.4: U-value calculation with a variable layer

A calculation with a variable layer has a place-holder layer in the main window (item 1 in Figure 9.4, and has the additional **Variable layer** pane which accepts a number of different layers (item 2). Each of those layers shows the results of the U-value calculation *as if* that layer replaced the place-holder layer in the main calculation (item 3).

To use a variable layer:

1. In the main **U-value** window click the layer *below* the position for the variable layer.
2. On the **Insert** menu click **Variable layer**. The program inserts a variable layer in the calculation and displays the **Variable layer** pane (see Figure 9.4).
3. Select the blank layer in the **Variable layer** pane and add layers from the database, or by add and edit blank layers. The U-values for the constructions with the variable layer are shown alongside the variable layer materials: no U-value appears in the status bar.

   *When using the database, you must be ensure the contents of variable layer pane are showing in the **Construction** box of the **Products Database** dialogue.*

Once you have identified a configuration which gives the result you require you can convert the variable layer calculation into a standard U-value calculation:

1. Click the layer in the **variable layer** pane which you want to use in the standard calculation.
2. On the **Edit** menu click **Move selected variable layer into construction**.
3. The variable layer is deleted and the selected layer is inserted as a standard layer.

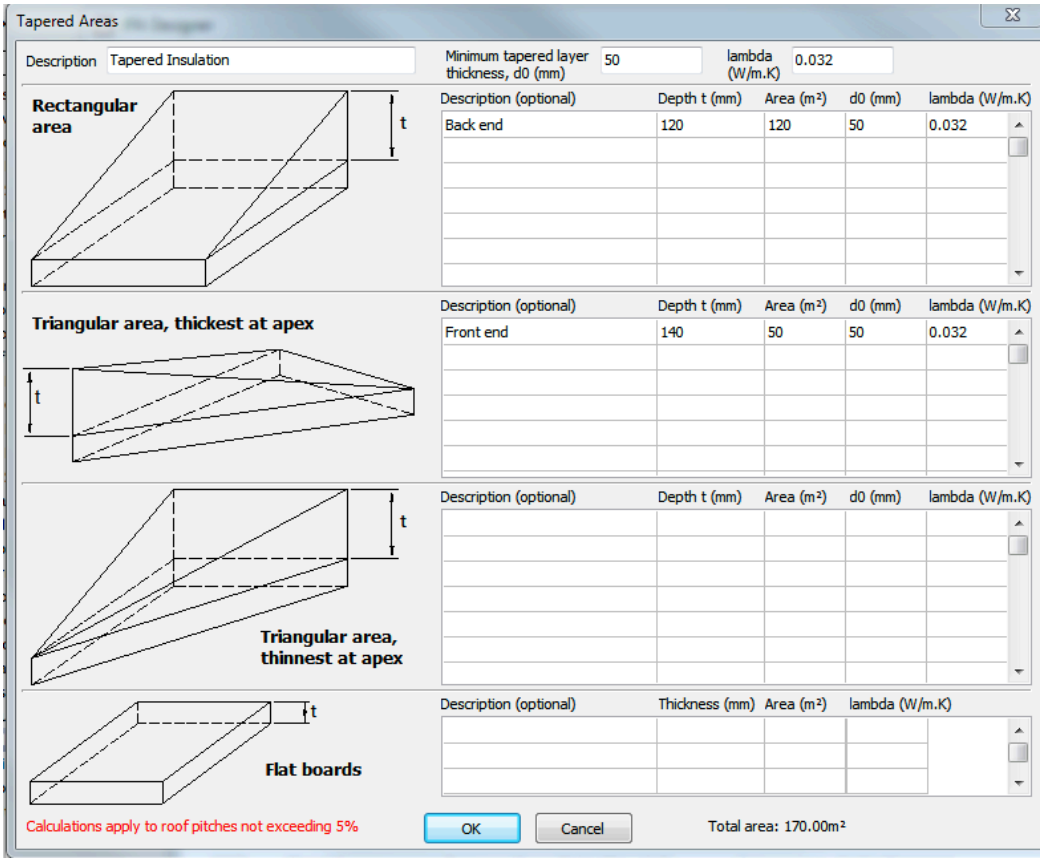


Figure 9.5: The Tapered Areas dialogue

9.5 Tapered layers

Tapered insulation layers are commonly found on flat roofs, to create drainage falls on an otherwise flat deck. Because the thickness of the insulation varies across the roof the average U-value of the roof has to be calculated using the method in Annex C of BS EN ISO 6946:2007.[1].

The method requires the roof to be divided into a series of blocks, which will be of:

- rectangular plan, with their greatest thickness on one side, and least at the other other;
- triangular plan which have their thickest part at the one corner and slope down to the other corners;
- triangular plan which have their thickest part along one side, and slope down to the other corner.

Each block in the calculation has a minimum thickness of insulation, *d0*, and a taper height, *t*. Depending on its size a roof may have several blocks of each type, each with different areas and, in some cases, different minimum thicknesses.

In JPA Designer a tapered layer calculation is entered in two parts;

[1] Note that simply calculating the U-value based on the average thickness of insulation will substantially over-estimate the thermal performance of the roof.

- all layers except the taper are added to the calculation;
- the individual blocks of the tapered layer are defined in the **Tapered Areas** dialogue (Figure 9.5).

The **Tapered Areas** dialogue requires three items of general information:

- a **description** of the layer: you can use the name or type of insulation.
- the **minimum tapered layer thickness**: that is, the minimum depth of the insulation layer which is continuous across all parts of the roof, measured in mm.
- the conductivity of the insulation, **lambda**: this is entered in W/mK.

The data on the different roof blocks is entered in the three tables , with each block having its own entry, in the appropriate section, with the following data:

- an optional **Description** which is useful for identifying sections of the roof;
- the taper depth, **t**, in mm.
- the area of the block, in m^2;

If a block has a different minimum depth compared to the rest of the roof, or has insulation with a different thermal conductivity you can insert a different value for **d0** and **lambda**.

Figure 9.6 shows a roof with tapered insulation laid with falls towards the perimeter. To calculate the U-value the tapered layer should be divided into eight blocks, with two (a and e) being rectangles sloping from the centre line to the perimeter and the remainder being triangles, in each case sloping from the highest corner at the centre line to the lowest side at the perimeter (b, c, d, f, g and h).

To enter a tapered layer in an existing U-value calculation:

1. Divide the roof into blocks and calculate the minimum thickness, block areas and taper thicknesses.
2. On the **Insert** menu click **Tapered layer**.
3. Enter the data for the minimum thickness and the conductivity of the insulation.
4. Enter the data for each block in turn, making sure each block goes into the appropriate table.

   *You can use the **Total area** figure at the bottom right of the dialogue to check you have entered all the sections of the roof.*

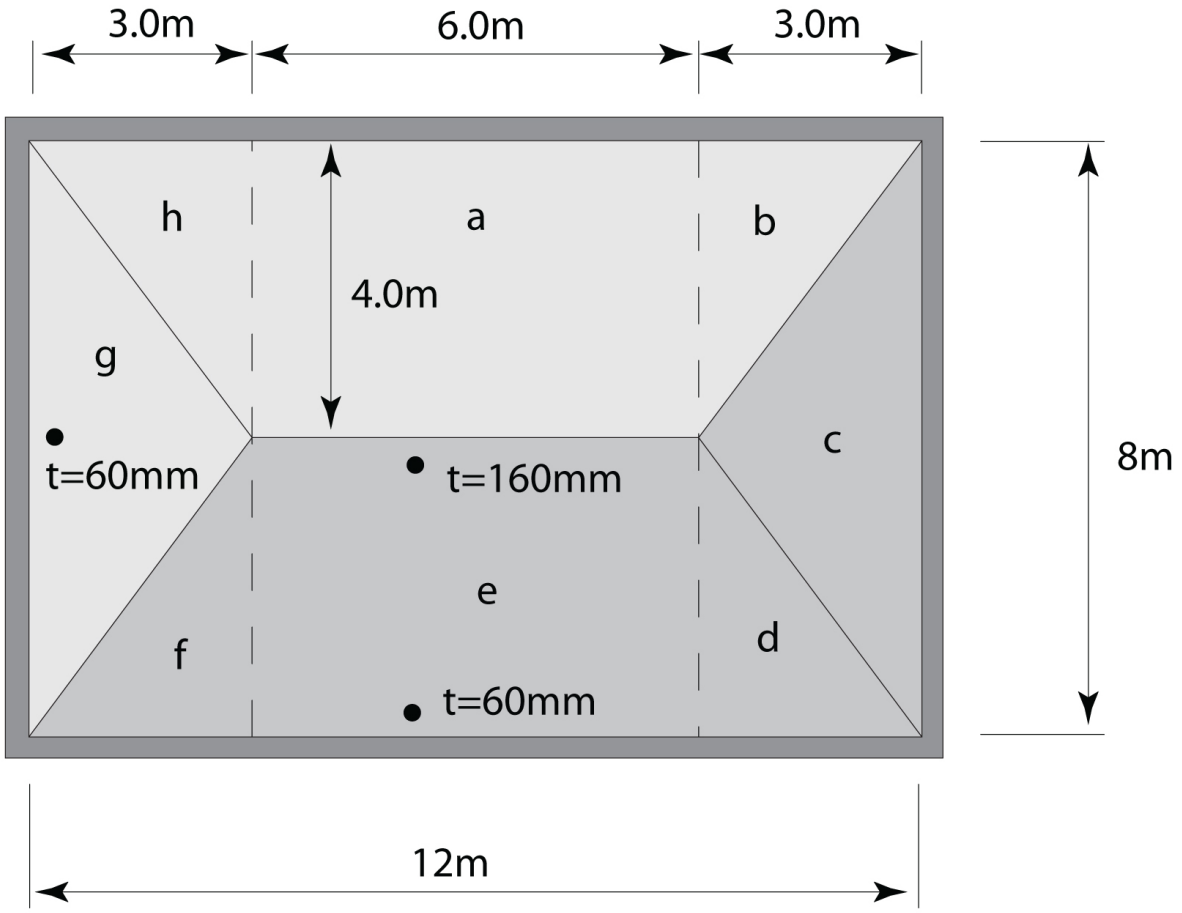


Figure 9.6: A typical roof with tapered insulation

10 Ground floor U-values

The standard method of calculating U-values has to be modified for ground floors and basements to take account of the thermal resistance of the ground using the method is set out in ISO 13370[1]. This section describes the general procedure for calculating the ground floor U-value, whilst the following sections describe the individual parts of the calculation.

To calculate a ground floor U-value:

1. Create a new U-value calculation in the **Project Manager** window and open it for editing (section 3.7).
2. Enter any project information in the **Project Information** dialogue.
3. In the U-value Construction dialogue select *Solid ground floor* or *Suspended ground floor*, enter a description for the construction, then click **OK**. The **Ground Floor Details** dialogue opens.
4. Enter the data for the ground (section 10.1). Click **OK**.
5. Add the remaining layers of the floor construction.

Include layers to represent:

- Screed;
- Insulation;
- Flooring, such as particle board.

Omit:

- Hardcore beneath a groundbearing slab.
- Groundbearing concrete slabs with density greater than 1800 kg/m^3.
- Thin floor coverings such as vinyl or carpet.

For further guidance refer to the BR 443 *Conventions for U-value calculations*.

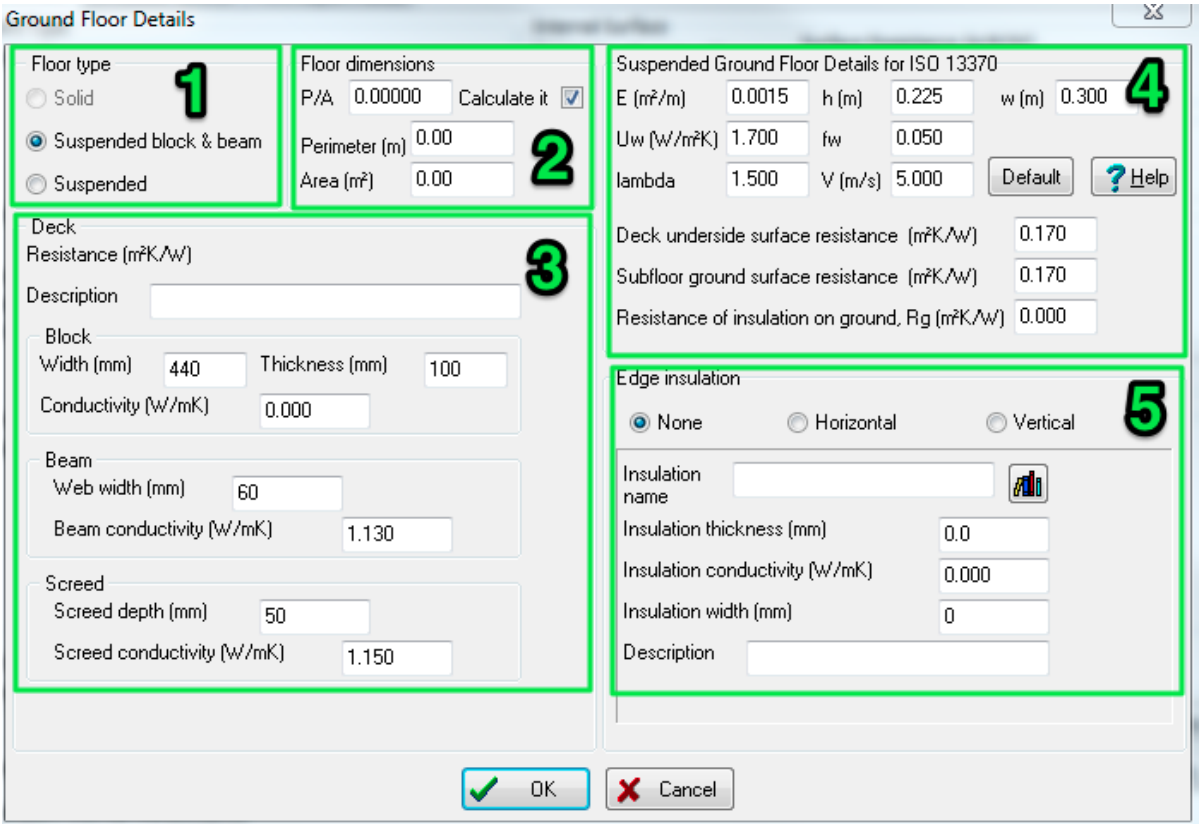


Figure 10.1: The Ground Floor Details Dialogue

10.1 Ground floor details

The **Ground Floor Details** dialogue contains the data which describes the ground and the floor structure (Figure 10.1) and has five sections:

- *Floor type* (section 10.1–1). The choice of floor type will determine how other parts of the dialogue appear.
- *Floor dimensions* (section 10.1–2). The size of the floor.
- *Deck* (section 10.1–3). The construction of a suspended floor deck.
- *Suspended ground floor details* (section 10.1–4). Additional information for suspended floors.
- *Edge insulation* (section 10.1–5). Details of any separate perimeter insulation.

Floor type

JPA Designer recognises three types of ground floor:

- *Solid*: a floor which bears directly on the ground with no void between the floor structure and the ground, for example, a ground-bearing concrete slab;

[1]Do not use this method to calculate U-values of floors over open or unheated spaces such as car parks or garages; instead select *floors other than ground floors* in the **Construction** dialogue and proceed as usual.

- *Suspended block and beam*: with a void between the floor deck and the ground, with the deck formed from pre-cast concrete beams infilled with concrete blocks or proprietary insulating units;
- *Suspended*: a floor with a void between the floor structure and the ground, with a timber deck supported on timber joists.

If you have selected *solid ground floor* in the **U-value Construction** dialogue the **Floor Type** buttons will be greyed out. If you have selected *suspended ground floor* you will be able to chose between *Suspended block and beam* and *Suspended*.

Floor dimensions

The thermal resistance of the ground for a particular floor is affected by the ratio of its perimeter and area. The perimeter length (expressed in metres) is measured along the finished internal surfaces of exposed and semi-exposed walls. The area (expressed in square metres, m^2) is measured between the finished internal wall surfaces. Unheated spaces outside the insulated fabric should be excluded when calculating the perimeter and area.

To enter the Floor dimensions:

- If you have calculated the Perimeter/Area ratio you can enter it directly in the **P/A** box.
- Alternatively, tick the **Calculate it** box and enter the **Perimeter** and **Area** dimensions.

Deck

The data required for this section depends upon the type of construction specified in the **Floor Type** section:

- Solid floor: no deck data required.
- Suspended block and beam floor (Figure 10.2): the program calculates the resistance using the following data:

  +The block **Width**, **Thickness** and **Conductivity**. + The beam **Web width** and **Beam conductivity**. + The **Screed depth** and **Screed conductivity**.

  *You can set the default thermal conductivity of the screed in a beam and block floor construction on the **Other** tab of the **Options** dialogue in **Project Manager**.*
- Suspended floor: you can enter a resistance for the deck, or select a material from the database (Figure 10.3) by clicking the database button (the procedure for selecting the material is the same as described in section 6.1. The deck in a suspended floor will typically be timber boards or particleboard: insulation between joists should be entered as a separate layer, bridged by timber (section 7.4).

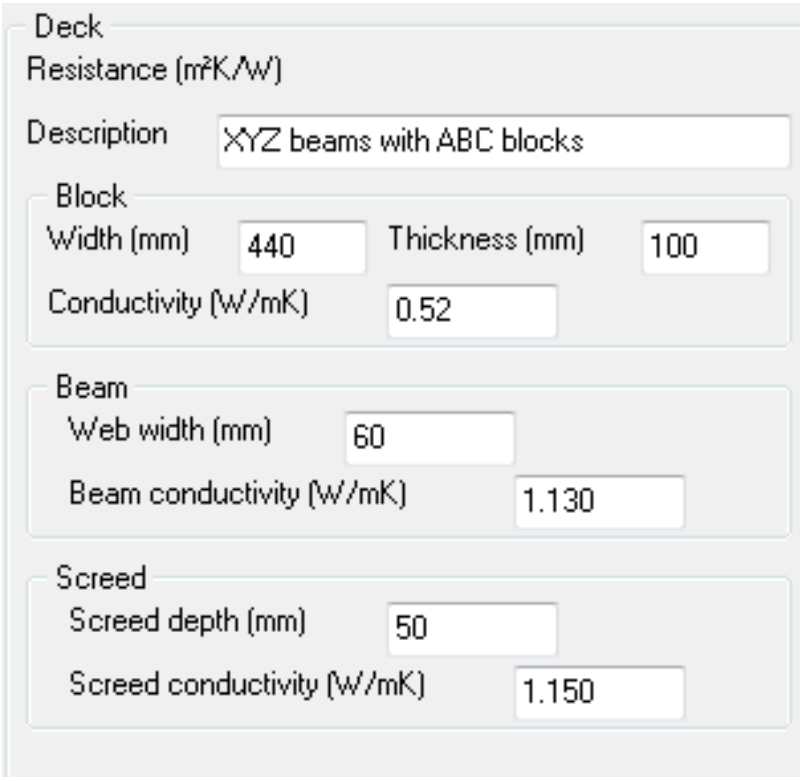


Figure 10.2: Defining a beam and block deck

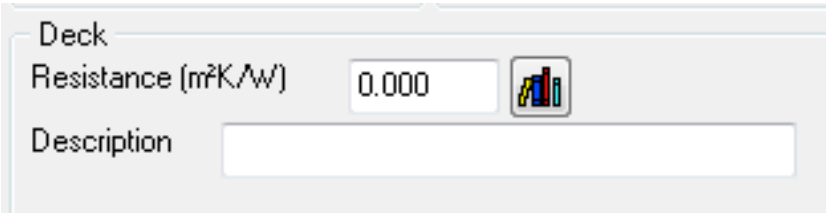


Figure 10.3: Set the deck resistance for a suspended floor

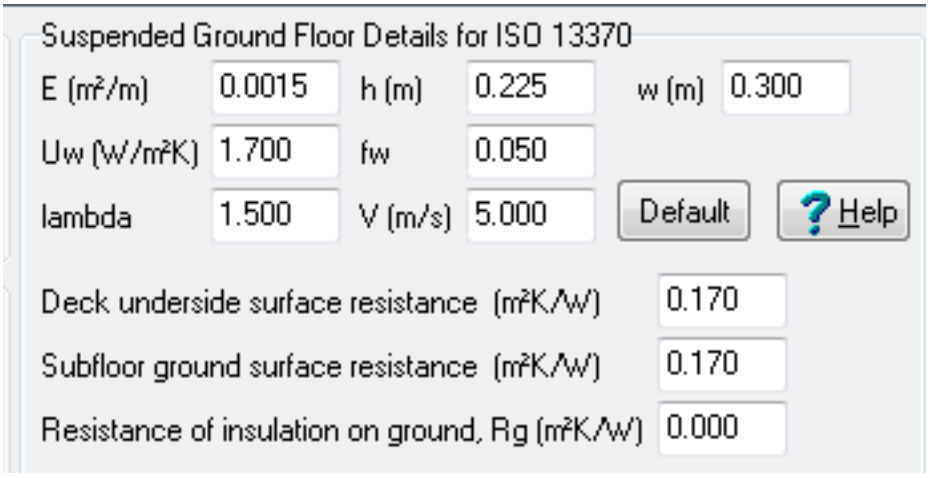


Figure 10.4: Entering the details for a suspended ground floor

Suspended ground floor details

In a suspended ground floor heat will be lost through the floor deck and ground; it will also be lost through the walls of the sub-floor void and as a result of ventilation of that void. JPA Designer calculates those latter heat losses using the data in **Suspended Ground Floor Details** section (Figure 10.4). The values required are:

- **E** - the area of ventilation openings in the walls of the sub-floor void, measured in square metres per metre (m^2/m).
- **h** - the height of the upper surface of the floor above external ground level, in metres. The default value of 0.225 m represents three courses of brickwork
- **w** the thickness of the walls at the floor perimeter in metres.
- **Uw** - the U-value of the walls of the sub-floor void, calculated according to BS EN ISO 6946, in W/m^2K. This value can be obtained from a separate calculation in JPA Designer.
- **fw** - the wind shield factor, see Table 10.1. This converts the average wind speed, **V**, into the wind speed at ground level.
- **Lambda** - the conductivity of the type of ground: use 1.5 W/m^2K for clay or silt, 2.0 W/m^2K for sand or gravel and 3.5 W/m^2K for homogeneous rock.
- **V** - the average wind speed at 10 m above ground level, in m/s. (BR 443 recommends a default value of 5 m/s for the UK.)

Where some or all of these details are unknown you should use the default values. If you edit the values then want revert to using the defaults click the **Default** button.

The surface resistances of the underside of the suspended deck and of the ground surface of the sub-floor void are included in the calculation. These are entered in **Deck underside surface resistance** and **Subfloor ground surface resistance**. In most cases a value of 0.17 m^2K/W is suitable, however, if the underside of the deck has a low emissivity surface (for example the foil facing of an insulation board), then a higher resistance may be used.

The resistance of any thermal insulation on the ground surface of the sub-floor void, *Rg*, should be entered at **Resistance of insulation on ground** (This insulation should *not* be entered as a normal layer in the calculation.)

Details for solid ground floors

The U-value calculation for solid ground floors requires three pieces of data from the *Suspended ground floor details* section: the height of the floor surface above the ground (**h**), the width of the walls (**w**) and the conductivity of the ground (**Lambda**).

Table 10.1: Windshield factor

Location	Example	Fw
Sheltered	City centre	0.02
Average	Suburban	0.05
Exposed	Rural	0.10

Edge insulation

Installing insulation horizontally around the perimeter of the floor – edge insulation – will reduce thermal bridging at the perimeter and improve the floor's overall thermal performance[2]. Edge insulation can be:

- Horizontal: insulation installed around the perimeter of the floor in the same plane as the floor[3].
- Vertical: insulation installed at the perimeter of the floor, at right angles to the plane of the floor.

Use the radio buttons to select the type of edge insulation present: *none*, *horizontal* or *vertical* then enter the details of any insulation (if you have selected *none* leave the rest of this section blank).

- **Insulation name**.
- **Insulation thickness**: board thickness, in mm.
- **Insulation conductivity**: the lambda value, in W/mK.
- **Insulation width** or **depth** (depending upon whether the insulation is laid horizontally or vertically): the board width, in mm.
- **Description**: optional description of the insulation.

You can also use the **Products Database** to enter details of the insulation by clicking on the button by the **Insulation name** box.

Further information on edge insulation may be found in BRE Information Paper 7/93.

[2]For suspended floors edge insulation refers only to insulation applied at the base of the subfloor void: insulation around the edge of the deck should not be included as edge insulation.

[3]Horizontal edge insulation was commonly used to reduce thermal bridging and cold spots on larger floors which did not require a complete layer of thermal insulation. However, the lower U-values now required by Building Regulations usually require a full layer of insulation, making the use of horizontal edge insulation unlikely.

11 Basement U-values

JPA Designer calculates U-values for basement walls and floors using the methods in in BS EN ISO 13370. As the calculations for a basement's walls and floor are linked, with each calculation requiring data about the other element, it is beset to calculate the basement floor U-value first.

11.1 Basement floors

Figure 11.1: Entering data for basement floors

To complete a basement floor U-value calculation you will need to know:

- The floor's Perimeter/Area ratio: *P/A*;
- The thickness of the basement walls: *w* (metres);
- The average depth from the external ground surface to the basement floor: *h* (metres);
- The thermal conductivity of the ground: lambda, λ, in W/mK (see Table 11.1 and annex G of BS EN ISO 13370).

To calculate a basement floor U-value:

1. Create a new U-value calculation in the **Project Manager** window and open it for editing.
2. In the **U-value Construction dialogue** set the **Element Type** to *Basement Floor*, enter an **Element description** then click **OK**.
3. In the **Ground Floor Details** dialogue (Figure 11.1) enter:
    - the Perimeter/Area ratio, **P/A**, or check the box labelled 'calculate it' and enter the **Perimeter** and **Area** separately;

- the wall thickness, **w**;
- the basement depth, **h**; and,
- the thermal conductivity of the ground.

4. Enter the layers which make up the floor construction.

Include layers to represent:

- Screed;
- Insulation;
- Flooring, such as particle board.

Omit:

- Hardcore beneath a groundbearing slab.
- Groundbearing concrete slabs with density greater than 1800 kg/m^3.
- Thin floor coverings such as vinyl or carpet.

Table 11.1: Thermal conductivity of the ground

Category	Description	Thermal conductivity, (W/mK)
1	clay or silt	1.5
2	sand or gravel	2.0
3	homogeneous rock	3.5

11.2 Basement walls

To complete a basement wall U-value calculation you will need to know:

- The floor's Perimeter/Area ratio: *P/A*;
- The thickness of the basement walls: *w* (metres);
- The average depth from the external ground surface to the basement floor: *h* (metres);
- Details of the insulation in the basement floor.
- The thermal conductivity of the ground: λ, in W/mK) (see Table 11.1 and annex G of BS EN ISO 13370).

To calculate a basement wall U-value:

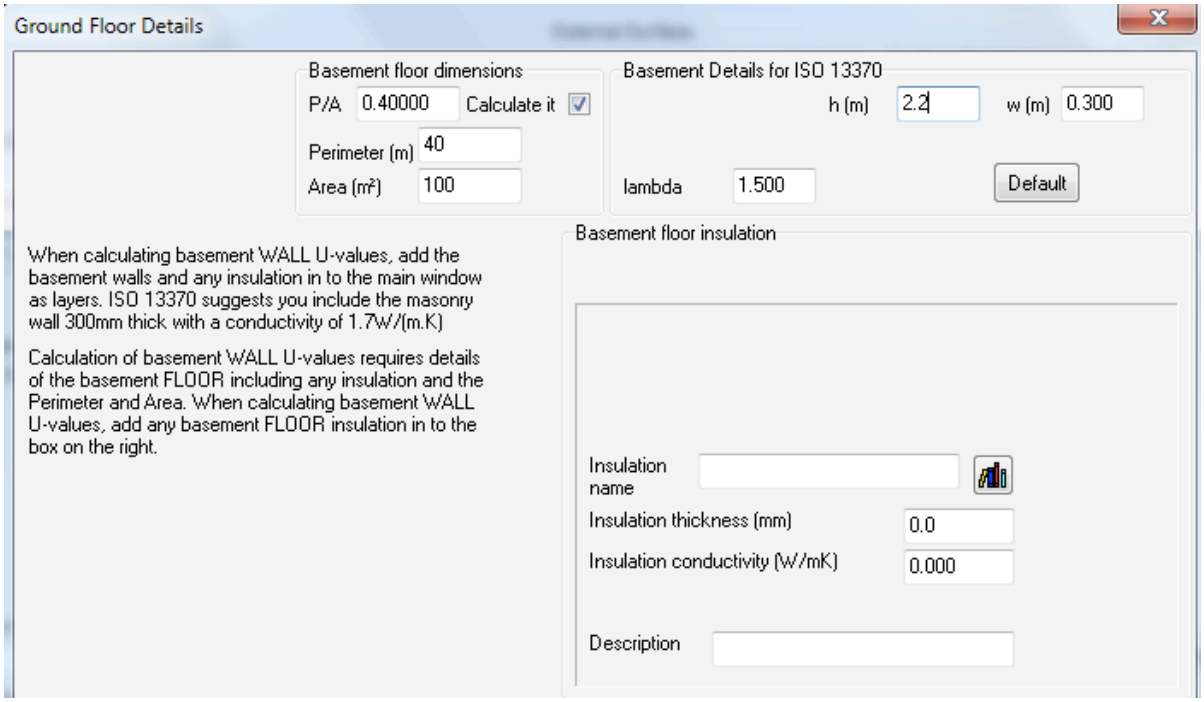

Ground Floor Details
Basement floor dimensions
P/A 0.40000
Calculate it
Perimeter (m) 40
Area (m²) 100
Basement Details for ISO 13370
h (m) 2.2
w (m) 0.300
lambda 1.500
Default
When calculating basement WALL U-values, add the basement walls and any insulation in to the main window as layers. ISO 13370 suggests you include the masonry wall 300mm thick with a conductivity of 1.7W/(m.K)
Calculation of basement WALL U-values requires details of the basement FLOOR including any insulation and the Perimeter and Area. When calculating basement WALL U-values, add any basement FLOOR insulation in to the box on the right.
Basement floor insulation
Insulation name
Insulation thickness (mm) 0.0
Insulation conductivity (W/mK) 0.000
Description

Figure 11.2: Entering data for a basement wall calculation

1. Create a new U-value calculation in the **Project Manager** window and open it for editing.
2. In the **U-value Construction dialogue** set the **Element Type** to *Basement Wall*, enter an **Element description** then click **OK**. The **Ground Floor Details** dialogue opens (Figure 11.2).
3. Enter the Perimeter/Area ratio, **P/A**, or check the box labelled 'calculate it' and enter the **Perimeter** and **Area** separately.
4. Enter the wall thickness, **w**, the basement depth, **h**, and the thermal conductivity of the ground, **lambda**.
5. Enter the details of insulation in the basement floor. Either enter the **name**, **thickness** and **conductivity** of the insulation, or use the database button to select the insulation from the **Products Database**.
6. Add the layers of the construction in the main **U-value** window.

12 Creating reports

You can print calculation reports or produce a PDF file which can be opened on any computer with the free Adobe Reader software installed. PDF files are ideal for emailing to people who need to see the results of the calculation but do not have JPA Designer. For both print and PDF the report includes:

- Project information;
- Details of the construction;
- The U-value and any correction factors.

To print results:

1. On the **File** menu click **Print** (or click the **Print** button on the tool bar). The **Sections To Print** dialogue opens (Figure 12.1).
2. If you have several user identities (see section 2.8) select the one you want to use in the **Identities** list.
3. Use the tick boxes to select whether to print an additional page showing the details of the bridging calculations. You can also choose whether to include the ISO moisture table for condensation analysis, and whether the calculation should show the logo of the BBA/TIMSA U-value accreditation scheme.
4. If you want to include a watermark over the calculation tick **Print watermark text**. You can also modify the wording, angle and font size of the default text.
5. Click **OK**. The **Print preview** window opens.
6. Use the buttons on the tool bar to view successive pages of the print out, then click the **Print** button to print the pages (Figure 12.2).

To create a PDF calculation report:

1. On the **File** menu bar select **Create PDF** (or click the PDF button on the toolbar). A dialogue asks if you want to open the PDF when it is created.
2. Select **Yes** or **No**. The **Sections To Print** dialogue opens (Figure 12.1).

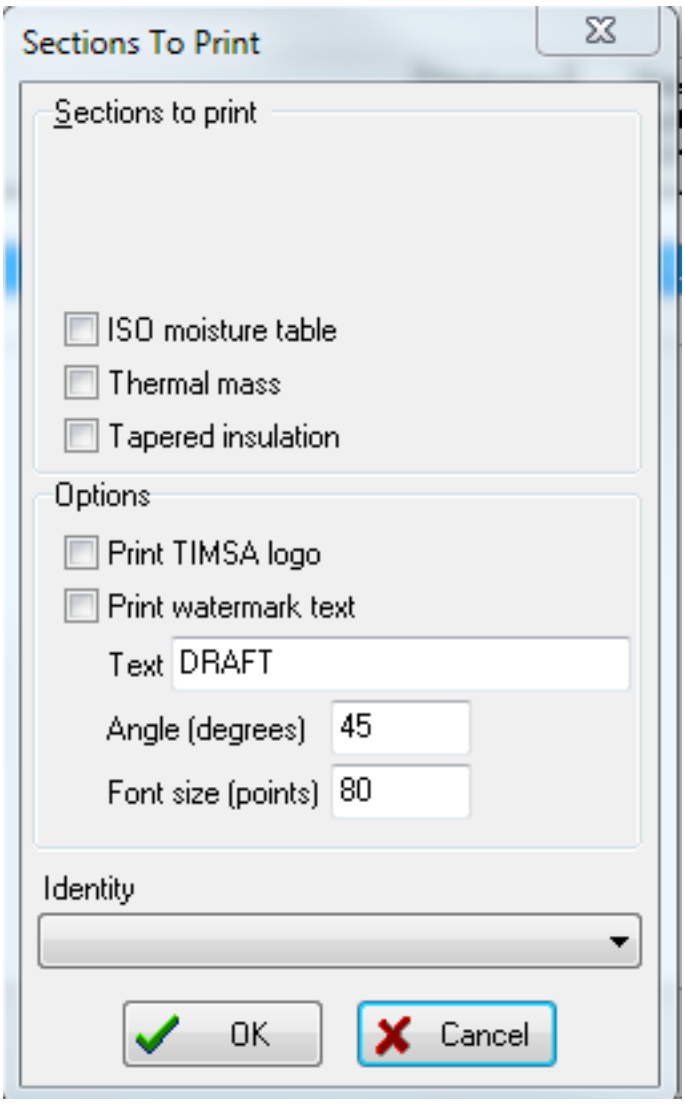


Figure 12.1: Sections To Print dialogue

Figure 12.2: Print preview controls

3. Use the tick boxes to select whether to print an additional page showing the details of the bridging calculations, tapered layers and, for condensation risk analysis, the ISO moisture table for condensation analysis. If you are a member of the BBA/ TIMSA U-value accreditation scheme you can add the scheme logo to your reports.
4. If you want to include a watermark over the calculation tick **Print watermark text**. You can also modify the wording, angle and font size of the default text.
5. If you have several user identities (see section 2.8) select the one you want to use in the **Identities** list.
6. Click **OK**. The **Print preview** window opens.
7. Use the buttons on the tool bar to view successive pages of the print out, then click the **Print** button to print the pages (Figure 12.2). The program will then create a PDF file of the calculation.

   *The name of the PDF file will include the JPA Designer file name and the calculation name, so the calculation **tile hung wall** in a project **The Meadows** will be called **The Meadows.JDPtile hung wall.PDF**.*
8. The file will be saved into the JPA Designer program folder or in the start-up folder you have specified (see section 3.5).

   Note: as Windows does not allow certain characters to be used in file names you should ensure the calculation names in JPA Designer do not contain those characters, otherwise PDF creation will fail. The restricted characters are: ' /\ : * ? < > |.

You can change the printer settings by selecting **File**>**Printer setup** from the menu bar.
It is also possible to produce PDF reports of all the U-value calculations at once. In the **Project Manager** window on the **File** menu click **Print all U-value calculations in this project to PDFs**. The program will then offer the **Sections to Print** dialogue before creating the PDFs.

12.1 Adding notes to reports

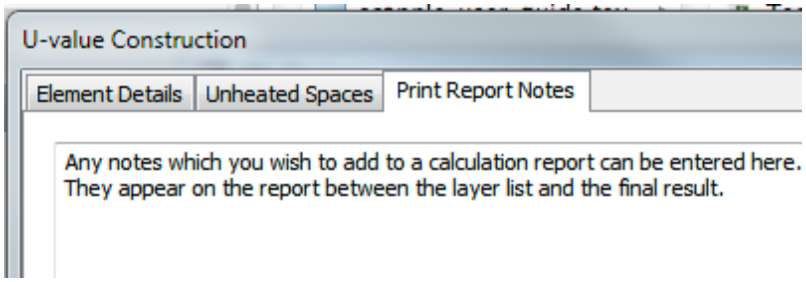

U-value Construction
Element Details
Unheated Spaces
Print Report Notes
Any notes which you wish to add to a calculation report can be entered here.
They appear on the report between the layer list and the final result.

Figure 12.3: The Print Report Notes tab in the U-value Construction dialogue

You can add notes to the report of a calculation, which can be used to explain particular features of the calculation or to highlight assumptions made within it.
To add notes open the **U-value construction** dialogue and click on the **Print Report Notes** tab. You can then enter your wording (Figure 12.3). The notes text will appear between the layers list and the final result.

12.2 Customising reports

You can control many aspects of the appearance of JPA Designer's calculation reports:

- Selecting the printer: In the U-value module select **File**>**Printer setup**. You can select the printer and paper source. It is possible to set the page orientation to landscape rather than portrait, but the reports are not designed for landscape format.
- Changing the font used in reports: In the U-value module select **File**>**Font**. Then in the **Font** dialogue. set the typeface, style and size. The default is Arial regular, 10 pt. Larger sizes may cause problems on the page with columns overflowing. Note also, that some fonts are wider than others, even at the same point size, so it worth testing font settings.
- Page margins: These are set in the **General** tab of the **Options** menu. There are two *Top* settings, one for the first page and one for the second page. This is to allow you to print calculations onto headed paper, with printing on the first sheet starting lower down the page.
- Adding your logo and address: You can add your logo and contact details to calculation reports: see section 2.8.
- Adding a disclaimer to be shown at the bottom of calculation reports: Enter the disclaimer text in the **U-value disclaimer** box on the **Options** dialogue **General** tab.
- Including the total construction thickness in the calculation report: In the **Other** tab of the **Options** dialogue tick **Print total thickness on U-value report**. The total thickness will then appear on calculation reports below the layer list.

13 Editing the Products database

To make U-value calculations easier all JPA Designer U-value modules include the **Products database**, which provides key data on generic construction materials and cavities,as well as data on branded products from a number of manufacturers. This section explains how you can add frequently used products to the database.

The materials within the database are organised into three categories:

- Branded products from manufacturers, shown in **bold** in the categories list;
- Generic materials, shown in normal type in the categories list;
- User-defined materials, shown in *italics* in the categories list.

Whilst you can create, edit and delete user-defined categories and materials, you can not edit or delete branded or generic categories or materials. However, you can clone a generic or branded material and make changes to the cone, leaving the original untouched.

To make changes to the **Products database** you must first open the **Edit database** dialogue (Figure 13.1) by selecting **Edit**>**Database** from the main menu.

To add a user defined category:

1. Click the **New category** button.
2. Enter the name of the category in the **New category** dialogue.
3. Click **OK**. The new category is created.

To rename an existing user defined category:

1. Select a category by clicking on it.
2. Click the **Edit category** button. The **Edit category** dialogue opens.
3. Enter a new name then click **OK**. The category is renamed.

To clone a category:

1. Select the category to clone by clicking on it.

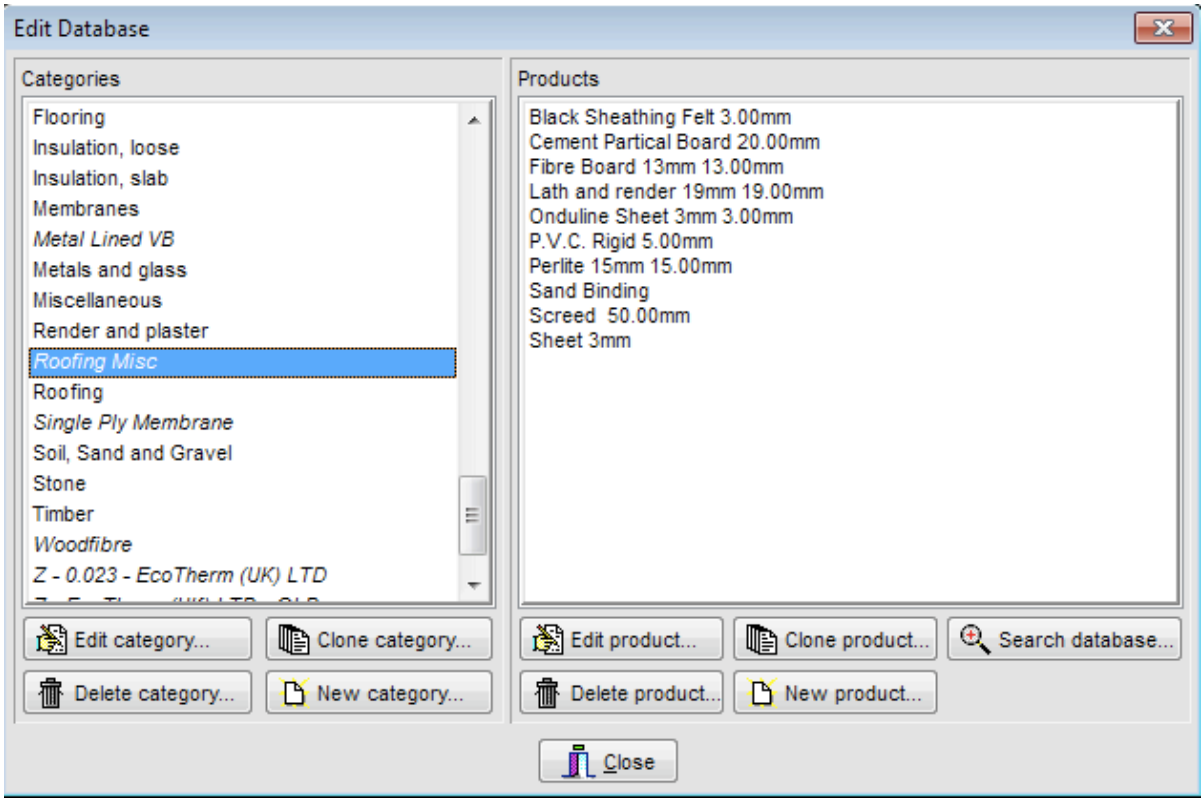


Figure 13.1: The Edit Database dialogue

2. Click the **Clone category** button. The **Clone category** dialogue opens.
3. Enter a name for the new category and click **OK**.
4. A new category will be created, containing copies of the original materials.

To delete a user defined category:

1. Select the category to delete.
2. Click the **Delete category** button. An **Information** dialogue asks you to confirm the deletion.
3. Click **Yes** to delete the category, **No** to keep it.

To insert a new material in a user-defined category:

1. Select the category in which you want to create the new material.
2. Click the **New product** button. The **Edit material** dialogue opens.
3. Complete the **Edit material** dialogue (chapter 7).
4. Click **OK**. The new product is added to the category.

To edit an existing user defined material:

1. Select the product you wish to edit.
2. Click the **Edit product** button. The **Edit material** dialogue opens.
3. Make the changes in the **Edit material** dialogue (chapter 7).
4. Click **OK**. The product information is updated.

To clone an existing product in a user defined category:

1. Select the product and click the **Clone product** button. A copy of the product will be inserted in the category.
2. Click on the clone to edit it.

To delete a product from a user-defined category:

1. Select the product you wish to delete.
2. Click the **Delete product** button. The product is deleted.

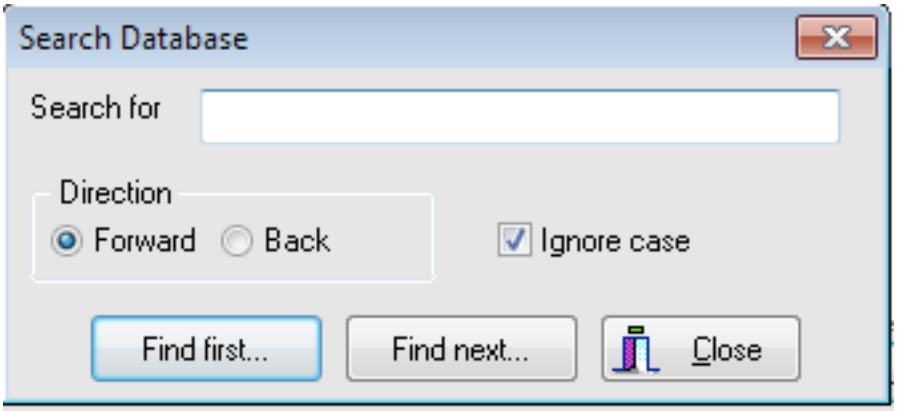


Figure 13.2: The Search Database dialogue

You can search the database to find specific products:

1. Click the **Search** button. The **Search Database** dialogue opens (Figure 13.2).
2. In the **Search Database** dialogue enter the text you want to search for and the direction the program should search through the database (*forwards* or *backwards*).
3. Tick the **Ignore case** box if you want the search to ignore capitals and lower-case letters.
4. Click **Find first** to start the search. The program will display the first matching product in the **Products** pane.
5. Click **Find next** to go on to the next matching product.
6. When you have found the product you want click **Close** to close the Search dialogue.

When you have finished working on the database, click the **Close** button to return to the main U-value window.

13.1 Short codes

You can assign codes to user defined materials as you enter them in the database. The short codes can then be used for rapid data entry using the Products database (section 6.1). You can also use short codes to determine the order in which products and materials are presented within categories, to speed up data entry for common constructions.

To sort the database by short codes you must first assign short codes to the materials; use a numbering system which matches the order in which you want the materials to appear. Once you have assigned short codes you should click on the **Sort on short code** tick box in the **Products database** dialogue (Figure 6.2).

Part III

Condensation risk

14 The problem of interstitial condensation

Condensation occurring within building elements – interstitial condensation – can cause substantial damage to the building fabric and reduce the effectiveness of thermal insulation[1]. By carrying out condensation risk analysis (CRA) you can identify constructions which are likely to be at risk of condensation and, where necessary, make modifications to the design.

JPA Designer assesses the risk of interstitial condensation using the steady-state method defined in ISO 13788:2012[2], which uses mean monthly temperatures and relative humidities to assess the risk of interstitial condensation over a twelve month period. The method provides a general assessment of suitability of the construction, but does not address air movement within the construction, nor does it take account of the effects of capillary moisture transfer.

[1] For further information on the causes and effects of condensation, and guidance on reducing problems see BS 5250:2011. Code of practice for control of condensation in buildings.

[2] ISO 13788:2012 Hygrothermal performance of building components and building elements – Internal surface temperature to avoid critical surface humidity and interstitial condensation – Calculation methods.

15 Condensation risk analysis in JPA Designer

Condensation risk analysis determines whether condensation is likely to occur at the interfaces between the layers of material which make up the construction[1]. Using the hygrothermal properties of the materials (section 15.1) and the environmental conditions (section 15.2) the program looks at each interface in the construction and calculates:

- the amount of condensate deposited or evaporated during each month of a year;
- the maximum amount of moisture deposited;
- the accumulated mass of water compared to total evaporation during the year;
- the annual moisture balance.

You can then use the results to assess the suitability of the construction for that environment.

To carry out condensation risk analysis:

1. Define the element in the same way as you would for a thermal calculation (section 15.1).
2. Set the environmental conditions (section 15.2);
3. View the results (chapter 16).

15.1 Defining the construction

To carry out condensation risk analysis you must set the thermal resistance and vapour resistance of each layer which makes up the element, using the appropriate methods for each type of layer:

- *Normal* materials: Enter the **thickness**, **thermal conductivity** and **vapour resistivity**. JPA Designer will calculate the **thermal resistance** and the **vapour resistance**.

[1] The module can not carry out condensation risk analysis for ground floors, basements nor constructions containing variable layers; neither will it calculate the risk of surface condensation.

- *Composite* materials: Enter the **thermal resistance** and **vapour resistance**. Although the **thickness** is not required for the calculation, setting the **thickness** ensures the Dewpoint graph (Figure 16.2) looks right.
- *Fixed vapour resistance* materials: These are designed to be used in condensation risk analysis to represent materials such as metals which have very high resistances even when used in thin layers. Enter the **thickness**, **thermal conductivity** and the **vapour resistance**.
- *Membranes*: Enter the **vapour resistance**.
- *Cavities*: Enter the **thermal resistance**. The vapour resistance of a cavity is always zero. Enter the **thickness** to ensure the the appearance of the Dewpoint graph.

The data for each type of material and cavity is described in more detail in chapter 7. If you have already carried out thermal calculations on the same construction you need only check that the vapour resistivity or resistance figures are correct.

Units of vapour resistance and resistivity

JPA Designer uses the vapour resistivity with units of MNs/gm and vapour resistance with units of MNs/g. If material data is quoted as μ or s_d values, multiply by five to obtain the resistivity or resistance respectively. You can find guidance on converting from European units and from permeability and permeance figures in Annexes E.7 and E.8 of BS 5250:2011.

15.2 Environmental conditions

The condensation risk calculation requires mean monthly data for:

- **External Temperature (Ext T)** and **External Relative Humidity (Ext RH)**; the external conditions depend upon the building's location. JPA Designer includes external temperature and humidity data for a number of weather stations around the UK and Ireland, allowing you to select the nearest location to the project site[2]. Pick the nearest weather station to your site.

  To view a map of locations click **View location of Google Maps**[3]. For a 'worst case' scenario select *Eskdalemuir*.
- **Internal relative humidity (Int RH)**; for buildings which are heated and naturally ventilated this is determined by the external relative humidity and moisture load generated by the activities taking place within the building. ISO 13788 defines five occupancy types with different humidity characteristics: BS 5250:2011 suggests relative humidity ranges for those types, see Table 15.1.

[2] The UK data is taken from Meteorological data 1961 –1990 published by the World Meteorological Office, while the data for the Republic of Ireland comes from the Met Éireann.

[3] Map courtesy of Andrzej Niedzielski.

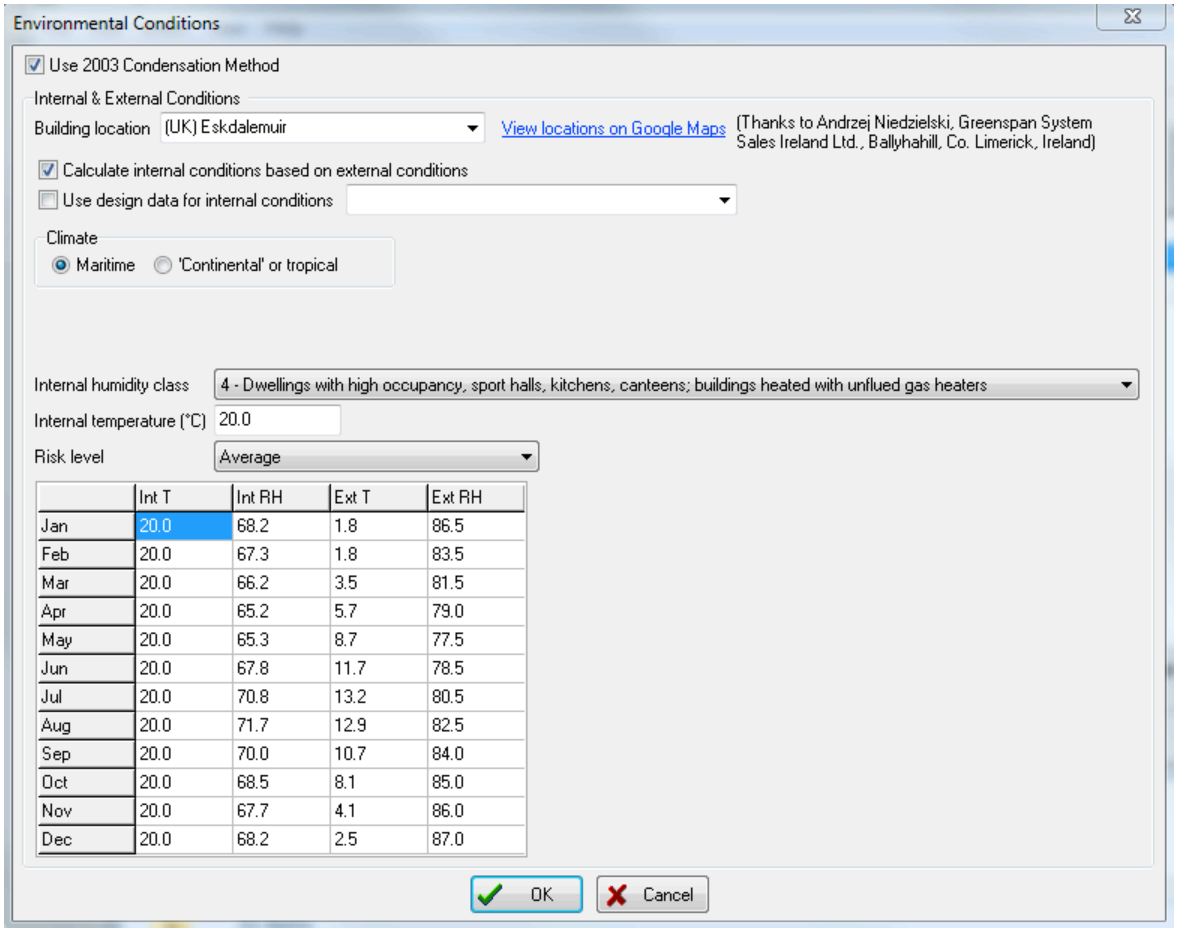

Environmental Conditions
Use 2003 Condensation Method
Internal & External Conditions
Building location (UK) Eskdalemuir
View locations on Google Maps
(Thanks to Andrzej Niedzielski, Greenspan System Sales Ireland Ltd., Ballyhahill, Co. Limerick, Ireland)
Calculate internal conditions based on external conditions
Use design data for internal conditions
Climate
Maritime
'Continental' or tropical
Internal humidity class
4 - Dwellings with high occupancy, sport halls, kitchens, canteens; buildings heated with unflued gas heaters
Internal temperature (°C) 20.0
Risk level
Average
Int T Int RH Ext T Ext RH
Jan 20.0 68.2 1.8 86.5
Feb 20.0 67.3 1.8 83.5
Mar 20.0 66.2 3.5 81.5
Apr 20.0 65.2 5.7 79.0
May 20.0 65.3 8.7 77.5
Jun 20.0 67.8 11.7 78.5
Jul 20.0 70.8 13.2 80.5
Aug 20.0 71.7 12.9 82.5
Sep 20.0 70.0 10.7 84.0
Oct 20.0 68.5 8.1 85.0
Nov 20.0 67.7 4.1 86.0
Dec 20.0 68.2 2.5 87.0
OK
Cancel

Figure 15.1: The Environmental conditions dialogue

- **Internal temperature (Int T)**; the design temperature inside the building, in degrees Celsius. The default for analysis is to use the same internal temperature throughout the year. If no project temperature has been specified use 20ºC as a default value for a UK building.

  For fully conditioned buildings it is appropriate to use design internal conditions, rather than derive them from the external conditions and moisture load.

- **Risk level**: As the available climate data is based on mean values averaged over thirty year periods, there will be some years which have better conditions than the mean and some years which will have worse. It is possible that constructions which are predicted to be free of condensation in average conditions will suffer condensation in colder and more humid years. BS 5250:2011 gives a method for testing the likely effect of worse than average years by means of risk years, with corrections to replicate the worst conditions likely over five, ten, twenty and fifty years. The appropriate return period for a calculation will depend on the sensitivity of the project to condensation: for example, a computer data centre might require a fifty year return period, while a house might only merit a five year return period.

The data is entered using the **Environmental conditions** dialogue (Figure 15.1):

1. On the **Edit** menu click **Environmental conditions**.

2. Make sure the **Use 2003 Condensation Method** is ticked (see chapter 17 for a description of the previous method).
3. Select the location of the building from the **Building location** list. The **Ext T** and **Ext RH** columns will be completed. If you have site specific data you can type values directly into the table.
4. For a naturally ventilated building:
    - Tick **Calculate internal conditions based on external conditions**.
    - Set the **Climate** to *Maritime*.
    - Select the humidity class in the **Internal humidity class** list. The **Int RH** column is completed.
    - Enter the internal design temperature in the **Internal temperature** box. The **Int T** column displays the values. If you wish to vary the internal temperature throughout the year you can type values directly into the **Int T** column for each month.
    - Set the **Risk level** from the list. Selecting a return period will make the external conditions more onerous, with longer periods being harsher than shorter ones.
5. For a conditioned building:
    - Tick **Use design data for internal conditions**.
    - From the list select a set of internal conditions. If you cannot find a suitable dataset in the list you may need to create the dataset before beginning analysis (see section 15.2.
6. Click **OK** to accept the data and close the dialogue.

Table 15.1: Humidity classes

Class	Building type	Relative humidity (%)		
		15ºC	20ºC	25ºC
1	Storage areas	<50	<35	<25
2	Offices, shops	50–65	35–50	25–35
3	Dwellings with low occupancy	65–80	50–60	35–45
4	Dwellings with high occupancy, sports halls,	80–95	60–70	45–55
5	Special buildings, e.g. laundry, swimming pool	>95	>70	>55

Creating new data sets

You can build up and save sets of internal and external environmental conditions to use in condensation risk analysis. This is particularly useful when examining air-conditioned buildings which have design values for temperature and humidity.

User data is stored in a file **Env_user.txt** which is kept with the other user data files in **c:\ProgramData\JPA\JPA Designer** (file location correct for Windows 7 - see Technical

note 2012/01 for other versions of Windows). Currently, the only way to add data sets is to edit **Env_user.txt** in a text editor, such as Notepad (Figure 15.2). Before editing **Env_user.txt** make sure JPA Designer is not running.

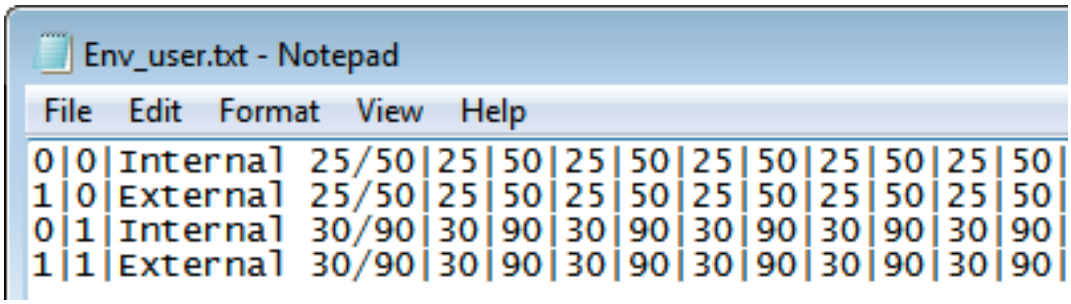


Figure 15.2: Editing the **Env_user.txt** file

Within **Env_user.txt** the data for an external location or an internal design condition is on one line, with each line separated by a return. On each line, the different items of data are separated by the pipe character, |, with no spaces before or after the pipe. The final character on every line is also a pipe.

The data items are:

- Item 1: whether the set is for internal conditions, 0, or external conditions, 1.
- Item 2: whether the set is system data, 0, or user data, 1.
- Item 3: a text description of the data set. This appears in the **Building location** or **internal conditions** lists, which are sorted alphabetically using the text description. This item can start with the tilde character (~), which does not appear on lists, but controls the way in which items 4–27 are interpreted.
- Items 4–27: these are the monthly temperature and relative humidity figures. Temperatures should be entered in degrees centigrade and relative humidity as a percentage. The order of the data depends on whether item 3 starts with a tilde (~).
  - If item 3 has a tilde the mean monthly temperatures should be entered in a sequence starting with January, followed by the relative humidity figures, starting with January (so: `Jan temp|Feb temp| … |December temp|Jan %rh|Feb %rh|` etc.)
  - If item 3 has no tilde the temperature and relative humidity values for each month should follow each other (so: `Jan temp|Jan rh|Feb temp|Feb %rh|` etc).
- Item 28: the country code. UK, 0. Republic of Ireland, 1. Australia, 2. New Zealand, 3. Asia, 4. Middle East, 5.
- Item 29: applies to external environmental sets and indicates whether internal conditions should be calculated on the basis of continental conditions, 1, or maritime conditions, any other value. This item is used only when internal conditions are to be derived from the external conditions: it is not used if fixed internal conditions are specified.

As an example:

`1|1|Newcastle Airport|3.4|92|…|4.2|89|0|0|`

This shows:

- External data (1).
- User data (1)
- Location, with no tilde.
- Paired monthly values for temperature (3.4 and 4.2) and relative humidity (92 and 89).
- UK (0)
- Maritime climate (0).

Once the environmental conditions have been entered and saved in **Env_user.txt** and JPA Designer started, the new data sets will show up in the **internal conditions** list. Note that the conditions will only show if their region matches the region selected for analysis.

If there are several users of JPA Designer within the same organisation the **Env_user.txt** file can be set up on one PC then copied to the others, ensuring everyone is using the same data sets.

16 Viewing results

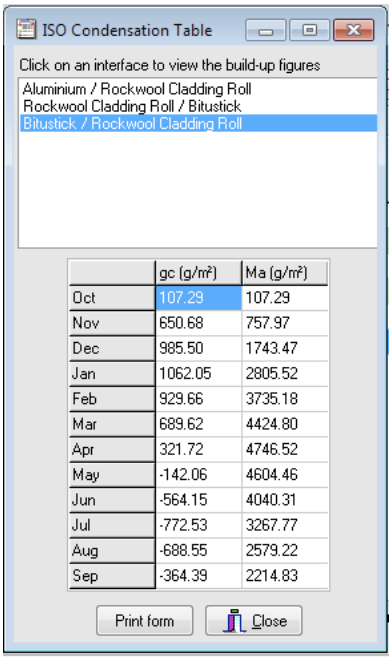
You can view the results of condensation risk analysis in three formats:

- As month by month data, in the ISO Condensation Table (section 16.1).
- As a graph, in the Dewpoint graph (section 16.2).
- In summary form, in the Results table (section 16.3).

16.1 ISO Condensation Table

The **ISO Condensation Table** shows the amount of condensate predicted at each interface in the construction, and is the most accurate means of viewing the results of an analysis to ISO 13788.

To view the **ISO Condensation Table**: on the **View** menu select **ISO Condensation Table**r.


ISO Condensation Table
Click on an interface to view the build-up figures
Aluminium / Rockwool Cladding Roll
Rockwool Cladding Roll / Bitustick
Bitustick / Rockwool Cladding Roll
Print form
Close

	gc (g/m²)	Ma (g/m²)
Oct	107.29	107.29
Nov	650.68	757.97
Dec	985.50	1743.47
Jan	1062.05	2805.52
Feb	929.66	3735.18
Mar	689.62	4424.80
Apr	321.72	4746.52
May	-142.06	4604.46
Jun	-564.15	4040.31
Jul	-772.53	3267.77
Aug	-688.55	2579.22
Sep	-364.39	2214.83

Figure 16.1: ISO 13788 Condensation table

The upper part of the window (Figure 16.1) shows the interfaces within the construction. When you select an interface by clicking on it, the lower half of the table shows the

amount of condensation predicted at that interface. It shows the amount of condensate deposited or evaporated each month, **gc**, and the accumulated condensate at the end of each month, **Ma**, both measured in g/m^2. A negative amount of condensate indicates the amount of moisture predicted to evaporate in that month.

The results always start with the first month in which condensation is predicted: if no condensation is predicted in any month results start with January. Guidance on interpreting results is given in ISO 13788 and BS 5250.

16.2 The Dewpoint graph

In condensation risk analysis the *dew point* is the temperature at which air would be saturated with vapour. Condensation occurs when the temperature at a point with in the construction drops below dew point and the air cannot support all the water vapour, resulting in some of the excess being deposited as liquid water.

The **Dew point graph** is a visualisation of the relationship between the predicted temperature through an element and the dew point. The orientation of the **Dew point graph** is determined by the building element: walls are shown with layers running vertically and roofs with layers running horizontally.

The graph shows two lines:

- the temperature gradient through the construction, calculated for each interface, shown in red; and,
- the dew point at each interface, shown in blue.

The lines are plotted for the month with the worst condensation conditions.

Where the two lines do not touch the actual temperature is above dew point and no condensation is predicted at those interfaces. Condensation is predicted at any interface where the two lines touch (see Figure 16.2). Note that the actual temperature will never be lower than the dewpoint and the lines will never cross.

To open the **Dewpoint graph**:

- on the **View** menu select **Dewpoint graph**; or,
- click the Dewpoint graph button on the tool bar.

To view the results for the month with the greatest evaporation, click the *Summer* button in the **Results to show** section.

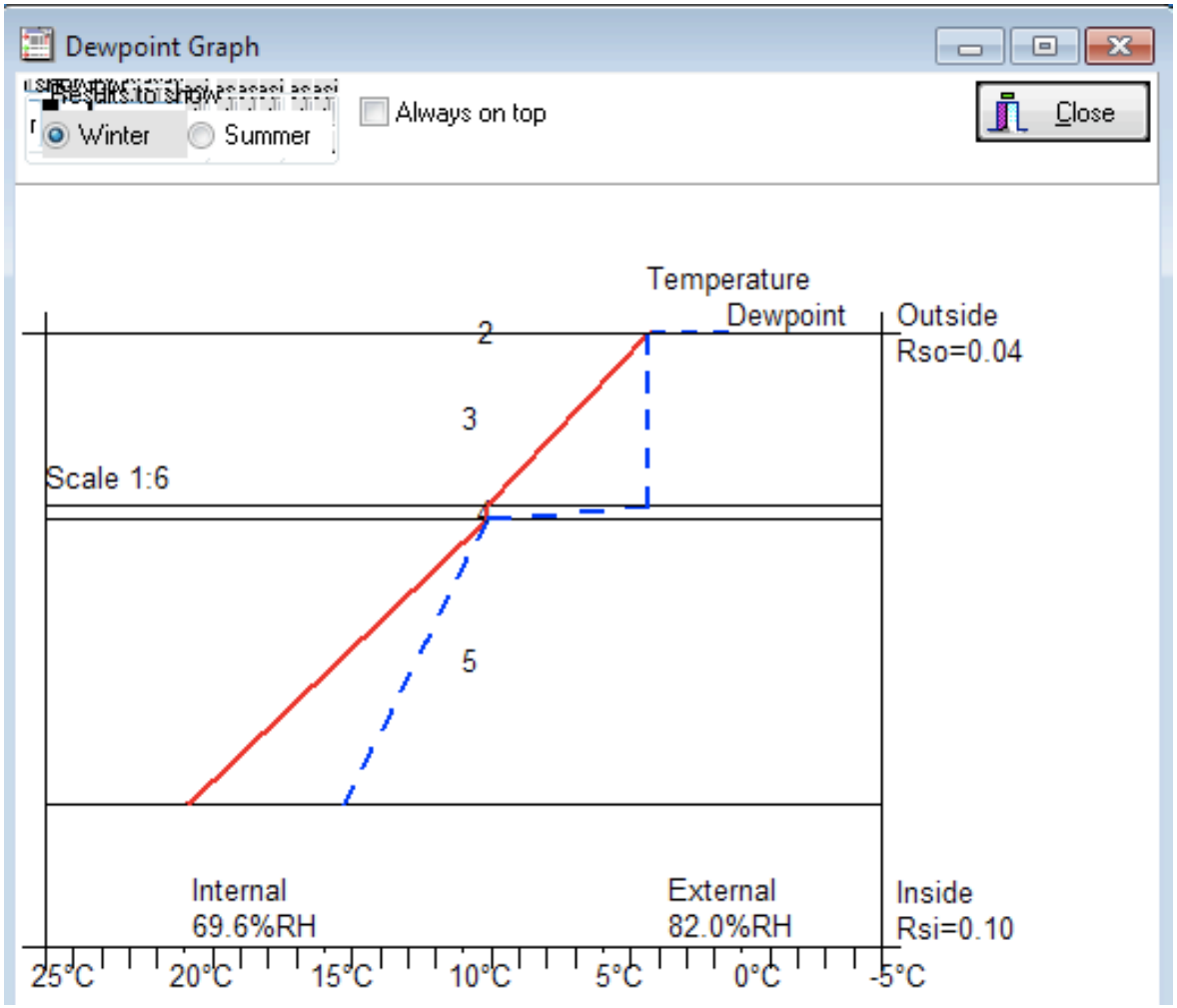


Figure 16.2: Dewpoint graph for a roof with condensation predicted at the interface between layers 4 and 5

16.3 The Results table

The **Results Table** shows the headline results for each interface in the construction. To view the **Results table**: on the **View** menu click **Results Table**. When the table is open click the **Always on top** box to keep it visible on screen while you continue to work on the calculation. When you have finished, click **Close** to close the Results Table.

For calculations to ISO 13788 the significant columns are:

- **ISO - Winter worst build up**: the month in which the highest amount of condensate is predicted to be deposited;
- **ISO - Winter peak build up**: the month which sees the highest cumulative amount of condensation.

For each column the amount of condensate is shown in grams per square metre g/m^2. The result *n/a* means no condensation is predicted at that interface. You can see more detailed results in the **ISO Condensation table.**

16.4 Producing reports

The results of condensation risk analysis can be printed or produced as PDF files in the same way as the results of thermal calculations (chapter 12).

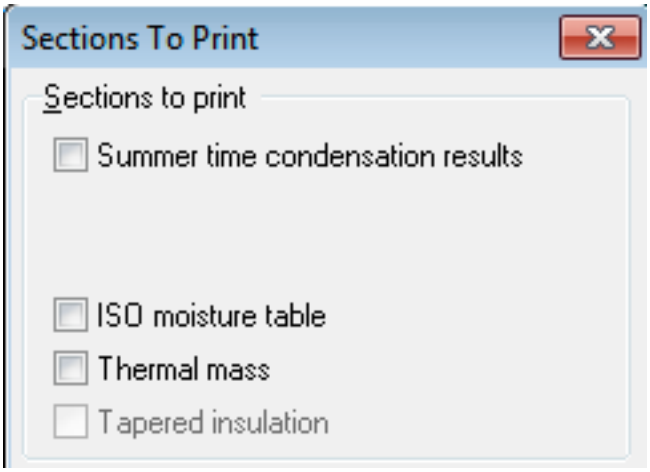


Figure 16.3: The Sections To Print dialogue for condensation risk reports

The main differences are:

1. Before starting to print or create a PDF, tick the **Condensation risk** box on the status bar at the bottom of the main **U-value** window.
2. In the **Sections To Print** dialogue review whether you want to print the summer-time condensation results and the ISO moisture table and tick the appropriate boxes.

17 Using the BS 5250:1989 calculation method

The BS 5250:1989 Appendix D method is based on the same underlying principles as the method set out in ISO 13788, but analyses condensation risk for a 60 period rather than the whole year and reports results in a different way. The Appendix D method is no longer referred to by building regulations and standards, but is still available within JPA Designer.

To use the BS 5250: 1998 calculation method open the **Environmental conditions** dialogue and untick **Use 2003 condensation method**. The dialogue box will now show the environmental data for the BS 5250:1989 method.

17.1 External conditions

The program sets standard values for external environmental conditions, following BS 6229:1982 and BS 5250:1989, which are:

- summer temperature: 18ºC.
- winter temperature: 5ºC.
- summer relative humidity: 65%.
- winter relative humidity: 95%.

If you need to calculate condensation risk for other external environments you can change the standard values by typing new values into the text boxes. To return to the default values for external environmental conditions click the **Default** button.

Build-up of condensate is assessed over a standard 60 day winter period: that value can be changed using the **Condensation build up period** box.

17.2 Internal conditions

The internal temperature and relative humidity values will be determined largely by the building use. You can enter design data or measured values in the four boxes, or select one of the pre-defined building use groups listed in **Building Use**, which are taken from BS 5250 and BS 6229, Table 7.

17.3 BS 5250:1989 results

Once you have set the environmental conditions you can view the calculation results using the **Results table** (section 16.3) and the **Dewpoint graph** (section 16.2). On the results table the important columns are:

- **Winter buildup** which shows the build up of condensate over the 60 day winter period; and,
- **Annual buildup** the amount of condensate carried over into the next year. A negative figure indicates there is no condensation carried forward.

Both figures are given in g/m^2.

17.4 Calculation options

The BS 5250:1989 method does not allow for the removal of moisture by air movement, however, the standard suggests some indication of the effect of vented cavities can be obtained by assuming the air in the cavity is at outside conditions. This can done by setting to zero the vapour resistances of the materials to the outside of a cavity.

For an explanation of the limitations of this technique please refer to BS 5250: 1989 page 76.

To use this option in JPA Designer:

1. In the **Options** dialogue go to the **Other** tab.
2. Tick **Set vapour resistance of layers above vented cavity to zero**.
3. Open the condensation risk calculation.
4. Double click on the cavity layer.
5. In the **Edit material** dialogue set the cavity type to **vented cavity**.

The program will set the vapour resistance of the layers outside the cavity to zero.

Part IV

SAP 2012

18 The JPA Designer SAP 2012 module

18.1 Overview of the SAP 20012 module

The JPA Designer SAP 2012 module enables you to carry out calculations to demonstrate a dwelling complies with the requirements of Part L 2013 (England) and Part L 2014 (Wales)[1]. The module also lets you issue energy performance certificates (EPCs) for new dwellings[2], whilst the results of calculations may be used as part of assessments under the Code for Sustainable Homes.

The SAP 2012 module uses the SAP 9.92 methodology to:

- calculate the Target Fabric Energy Efficiency (TFEE) and Dwelling Fabric Energy Efficiency (DFEE);
- calculate the Target Carbon Dioxide Emission Rate (TER) and the Dwelling Carbon Dioxide Emission Rate (DER).
- check for compliance against a number of other criteria set out in Approved Document L1A and in the Domestic Building Services Compliance Guide (2013 edition).

Whilst this section of the manual gives instructions on how to enter data into the program it does not offer authoritative guidance upon SAP 9.92 nor the Building Regulations. We suggest you use this manual in conjunction with the government's guide to SAP (available from the BRE web site - www.bre.co.uk/sap2012), Approved Document L1A and the Domestic Building Services Compliance Guide (both available as PDFs from the Planning Portal: www.planningportal.gov.uk).

18.2 Preparing to carry out a SAP 2012 calculation

Before starting a SAP calculation you should ensure you have all the input data, including:

- dwelling floor area;
- the ventilation strategy;

[1] For section 6 of the Scottish Building Standards 2010 (Scotland) and for Northern Ireland you should continue to use SAP 2009 - V9.90, which is described in the JPA Designer 5.01 user manual.

[2] In order to issue an EPC you will need to be a member of a government approved accreditation scheme. You can find more information on suitable accreditation schemes on our web site.

- the design or achieved air permeability;
- U-values, κ-values (kappa-values) and areas of external, and party, walls, roofs and floors (you can carry out the U-value and κ-value calculations using one of the JPA Designer U-value modules);
- κ-values and areas of internal walls and floors;
- ψ-values (psi-values) for junctions and the lengths of junctions;
- U-values, areas, orientation and glazing details of windows, doors and rooflights;
- the water heating system;
- the primary and secondary heating systems;
- details of any photovoltaic cells or other low carbon technology.

18.3 Carrying out a SAP 2012 calculation

Carrying out a SAP 2012 calculation using JPA Designer is straight forward. The main **SAP window** shows the on-going results of the calculation and the compliance status of the dwelling, while you enter data in the **SAP Worksheet Values** dialogue. Once you have finished entering data you can print off the results or make adjustments to the data. The main steps are:

1. Create a new SAP 2012 calculation (section 3.7).
2. Open the calculation in the SAP module (section 3.9).
3. Enter the **Project Information** (section 18.5).
4. Open the **SAP Worksheet Values** dialogue and enter the dwelling data (section 18.6).
5. Check the compliance status on the main **SAP window** (section 18.4) and make any necessary changes.
6. Produce print-outs or PDF files of the calculation reports (section 29.2).
7. Save your project (section 3.5).

18.4 The SAP window

The **SAP window** lets you access the SAP menus and tool bar and displays the results of calculations (Figure 18.1). The main features are:

1. The menu bar.
2. The SAP 2012 toolbar: the buttons give direct access to key program functions and to the tabs on the **SAP Worksheet Values** dialogue.
3. The status indicators which show how much data you have entered for each section of the calculation (see below for a more detailed description).

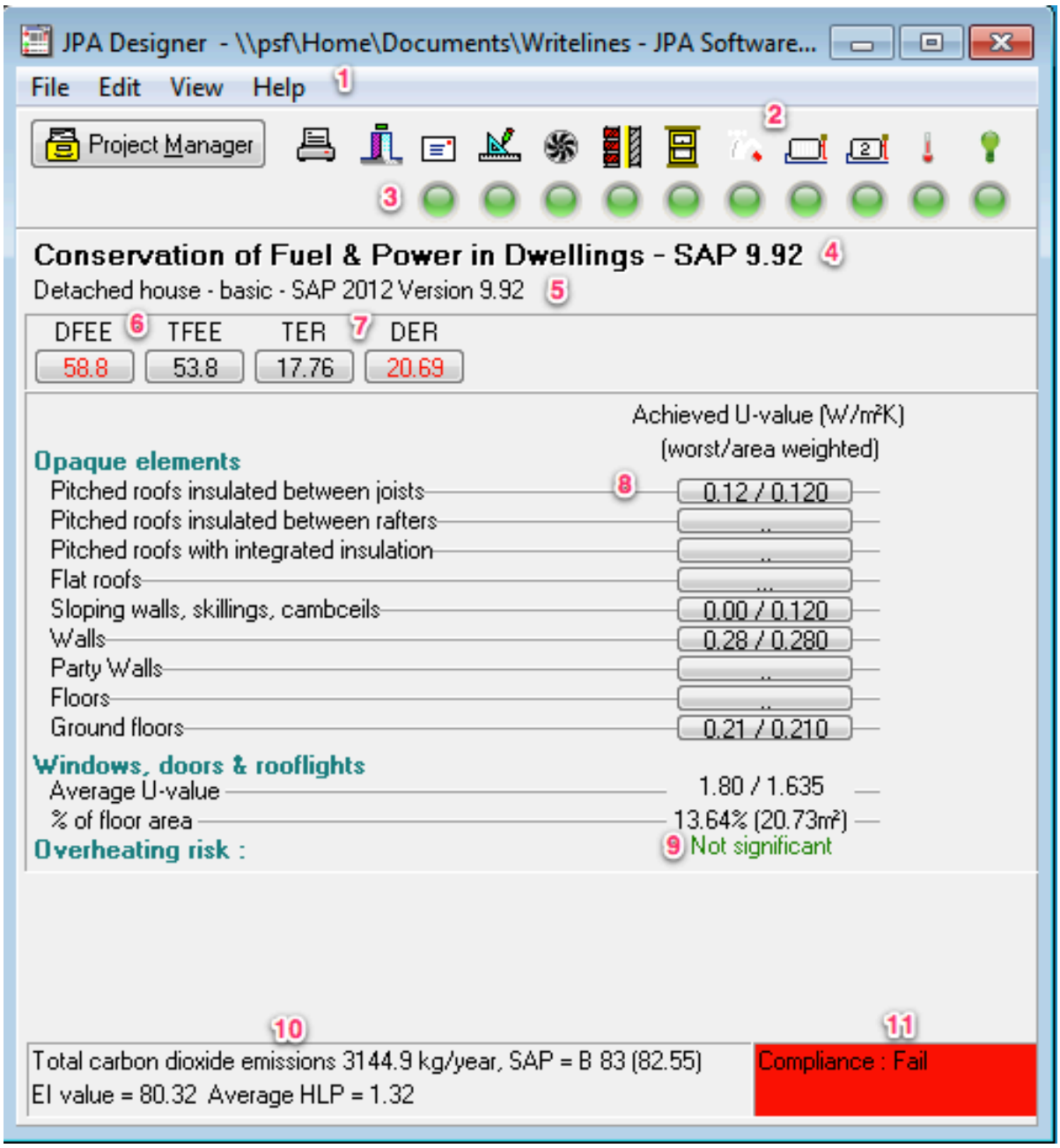


Figure 18.1: The main SAP window. 1 – Menu bar. 2 – Toolbar. 3 – Status indicators. 4 – SAP version. 5 – Calculation name. 6 – Fabric Energy Efficiency results. 7 – Dwelling emissions results. 8 – Fabric U-values. 9 – Overheating assessment. 10 – SAP rating. 11 – Compliance status.

4. The SAP version – in this case SAP 9.92, SAP 2012.
5. The calculation name, as entered in the **Project Manager** window.
6. The TFEE and DFEE results.
7. The TER and DER results.
8. Fabric U-values for opaque elements (floors, walls, roofs) and for openings. In each line the first number shows the worst (highest) U-value and the second the area-weighted average.
9. Overheating risk assessment.
10. Carbon dioxide emission and SAP results, including the average Heat Loss Parameter (HLP).
11. Compliance zone. This shows green for a pass and red for a fail. If the dwelling does not comply you can hold your mouse cursor over this zone to show a tool-tip identifying the primary cause of failure (Figure 18.2). Double clicking on the zone will open the **Compliance Checklist**.

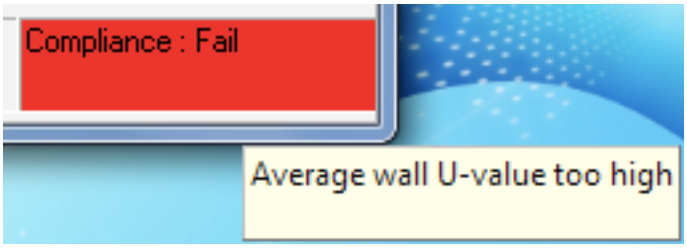


Figure 18.2: Tool tip showing the primary cause of failure

Figure 18.3: The SAP toolbar: 1 – Return to **Project Manager**. 2 – **Print**. 3 – Exit JPA Designer. 4 – *Project information* (section 18.5). 5 – *Dimensions* tab (chapter 19). 6 – *Ventilation* tab (chapter 20. 7 – *Walls, roofs and floors* tab (chapter 21). 8 – *Openings* tab (chapter 22). 9 – *Hot water* tab (chapter 23). 10 – *Primary heating* tab (chapter 24). 11 – *Secondary heating* tab – (chapter 25). 12 – *Overheating* tab (chapter 26). 13 – *Photovoltaic and alternative technologies* tab (chapter 28).

The toolbar buttons are shown in Figure 18.3; the majority of them open the **SAP 9.92 2012 Worksheet Values** dialogue at different tabs. The coloured status indicators below many of the toolbar buttons indicate the status of the data you have supplied for that part of the calculation:

- Red: There is none or very little data in that section.

- Orange: Most of the data is there, but one or two items in that section are still missing.
- Green: All the data necessary for completing the SAP calculation has been entered.

The indicators provide a quick way of seeing how far you have come in a calculation. However, you must remember the indicators refer only to the extent of data you have entered and have nothing to do with whether a dwelling will comply with regulations.

18.5 Project information in SAP

A SAP 2012 calculation requires general information about the project (such as the name and address of the client), the project address and basic information about the dwelling itself. All this information is entered in the **Project Information** dialogue (Figure 18.4), which is opened by selecting **Edit**>**Project Information** from the menu bar.

Address details

The client and project address details are shown on calculation worksheets and reports. The location of the dwelling, which affects some parts of the SAP calculation, is set using the project address details.

The client name and address, and the dwelling address should be typing into the appropriate fields (items 1, 2 and 3 in Figure 18.4) . Use the <Tab> key to move between fields. You can also use the **Inherit** button to use the address details for the project in the current calculation (see section 3.3 for instructions.) The **Pass down** button can be used to copy the address details to all other calculations in the project.

You can add plot numbers and drawing references to link the calculation to a set of drawings or a naming scheme. Note the **Date** (Figure 18.4 item 3) is used in an EPC lodgement as the survey date.

It is essential to enter a post code for the dwelling, as the EPC recommendations are based on local climate conditions, set by post code. Where the dwelling does not have a full post code – perhaps because it has not been assigned yet – you need only enter the first block, e.g. BT25. (However, the **UPRN** box and the **get UPRN** and **clear UPRN** buttons are only used when preparing to issue an EPC.)

Dwelling details

Project Information contains general information about the dwelling:

- **Building type** (Figure 18.4 item 7): this is used in the Energy Performance Certificate. Select the closest matching value from the drop-down. It is particularly important to select the correct option for flats.
- **Country**: the regional authorities in the UK have implemented SAP in slightly different ways. You must use the **Country** drop-down to select the correct location to ensure the dwelling is tested against the appropriate regulations.

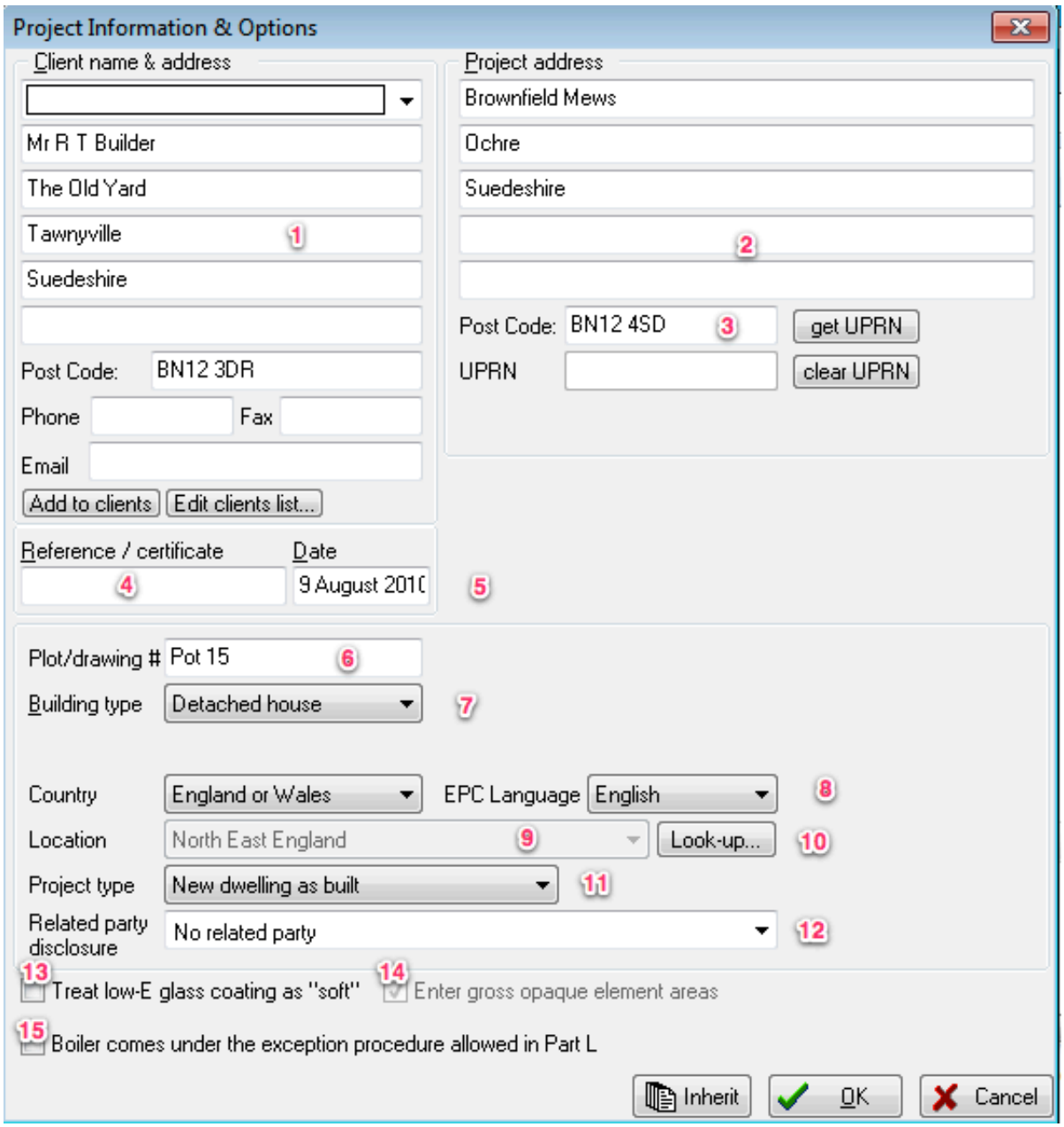


Figure 18.4: The Project Information dialogue

- **EPC language** (Figure 18.4 item 8): sets the language in which the EPC is produced.

  EPCs in England, Scotland and Northern Ireland must be produced in English. EPCs in Wales may be issued in in English or Welsh.

- **Location** (Figure 18.4 item 9): this is used to in the overheating assessment and in SAP calculations for dwellings with space cooling. To set the **Location** enter the Post code (Figure 18.4 item 3) , then click **Look-up** (Figure 18.4 item 10). The program then sets the region. There is a map of SAP regions in Table 10 of the SAP 2012 document.

  *Where the dwelling does not have a full post code – perhaps because it has not been assigned yet – you need only enter the first block – e.g. BT25 – for the **Location** look-up to work.*

- **Project type** (Figure 18.4 item 11): defines whether the calculation is for a *new build*, *existing dwelling* or *conversion*.

- **Related party disclosure** (Figure 18.4 item 12): overrides the default disclosure for EPCs for that calculation.

SAP calculation options

The bottom of the **Project Information** dialogue contains several calculation options:

- **Treat low e glass coating as 'soft'** (Figure 18.4 item 13): this is a legacy setting which affected calculations in SAP 9.70 and 9.80/1. It has no effect on SAP 2012 calculations.

- **Enter gross opaque element areas** (Figure 18.4 item 14): the SAP 2012 calculation uses the net areas of walls and roofs, after the areas of openings (doors, windows and rooflights) have been removed). If you select this option you can enter the *gross* areas of walls and roofs, and the program will determine the net areas, by subtracting the areas of windows and rooflights as they are specified.

  If you change the setting of this box the software then close the **Project Information** the program asks if you want to use that setting as the default value for future calculations.

  You can only change this setting *before* you have started to enter data in the **SAP Worksheet** dialogue. Once you have entered data the tick box will be greyed-out and inaccessible. This is to prevent the setting being changed halfway through a calculation and so avoid errors.

- **Boiler comes under the exception procedure allowed in Part L** (Figure 18.4 item 12): The Domestic Building Services Compliance guide requires new or replacement gas or oil boilers to have efficiency levels which can only be achieved by condensing appliances. A non-condensing boiler may be be permitted if the situation meets the conditions in the government's *Condensing boiler installation assessment procedure for dwellings*[3]. You may therefore only tick this box if the conditions of the assessment procedure are satisfied.

Once you have entered all the necessary data, click **OK**.

[3] Guide to the Condensing Boiler Installation Assessment Procedure for Dwellings. DCLG. 2005. http://www.planningportal.gov.uk/uploads/br/BR_PDF_PTL_CONDBOILER.pdf

18.6 Entering information about the dwelling

The data for the SAP calculation is entered using the **SAP 9.92 2012 Worksheet Values** dialogue. The dialogue has a series of tabs, each covering one part of the SAP input data:

- **Dwelling dimensions**: the basic configuration of the dwelling, including the proportion of low energy lighting (chapter 19).
- **Ventilation**: air infiltration rates, ventilation strategy and system efficiency (chapter 20).
- **Walls, roofs and floors**: heat loss and thermal mass of the opaque building fabric (chapter 21).
- **Openings**: heat loss, solar gain and daylighting information for windows, doors and rooflights (chapter 22).
- **Water heating**: the source of domestic hot water, its efficiency and fuel type, including details of any solar panels (chapter 23).
- **Primary heating**: the main heating system, controls and fuel (chapter 24).
- **Secondary heating**: any additional heating system (chapter 25).
- **Overheating and cooling**: details for summer overheating, and any fixed cooling systems (chapter 26 and chapter 27).
- **PV & Alt Tech**: Photo-voltaic panels, wind turbines, and new renewable technologies (chapter 28).

To open the dialogue at the start of a calculation, click on the **Dwelling dimensions** button on the toolbar or on the **Edit** menu click **Dwelling dimensions**.

The tabs are listed at the top of the dialogue in the same order as they appear in the **Edit** menu (Figure 18.5). To move between sections simply click on the tabs. We recommend you work from left to right, starting with **Dwelling Dimensions** and finishing with **PV & Alt Tech**.

Figure 18.5: Tabs on the SAP 9.92 2012 Worksheet Values dialogue

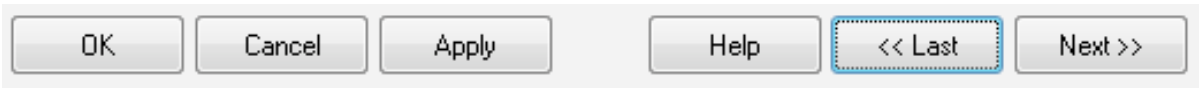


Figure 18.6: The buttons on the SAP Worksheet Values dialogue

At the bottom of the dialogue are a series of buttons (Figure 18.6):

- **OK**: Revises the calculation taking account of any changes you have made to the data, and closes the dialogue.

- **Cancel**: Closes the dialogue but ignores any changes you have made to the calculation.
- **Apply**: Revises the calculation, taking account of any changes you have made to the data, but leaves the dialogue open.

  *With a monitor set to 1024 by 800 pixels or higher, it is possible to see the main **SAP** window and the **SAP 9.92 2012 Worksheet Values** at the same time. By using the **Apply** button you can see the effect of design changes upon the calculation immediately.*
- **Help**: Gives you access to the government's SAP guidance and an on-line version of this manual.
- **Last**: Takes you to the previous tab.
- **Next**: Takes you to the next tab.

19 Dwelling dimensions

The **Dimensions** tab (Figure 19.1) is used to enter data on the:

- area and volume of the dwelling;
- living area of the dwelling
- low energy lighting;
- dwelling orientation.
- position of a flat or maisonette in a block (Scotland only).

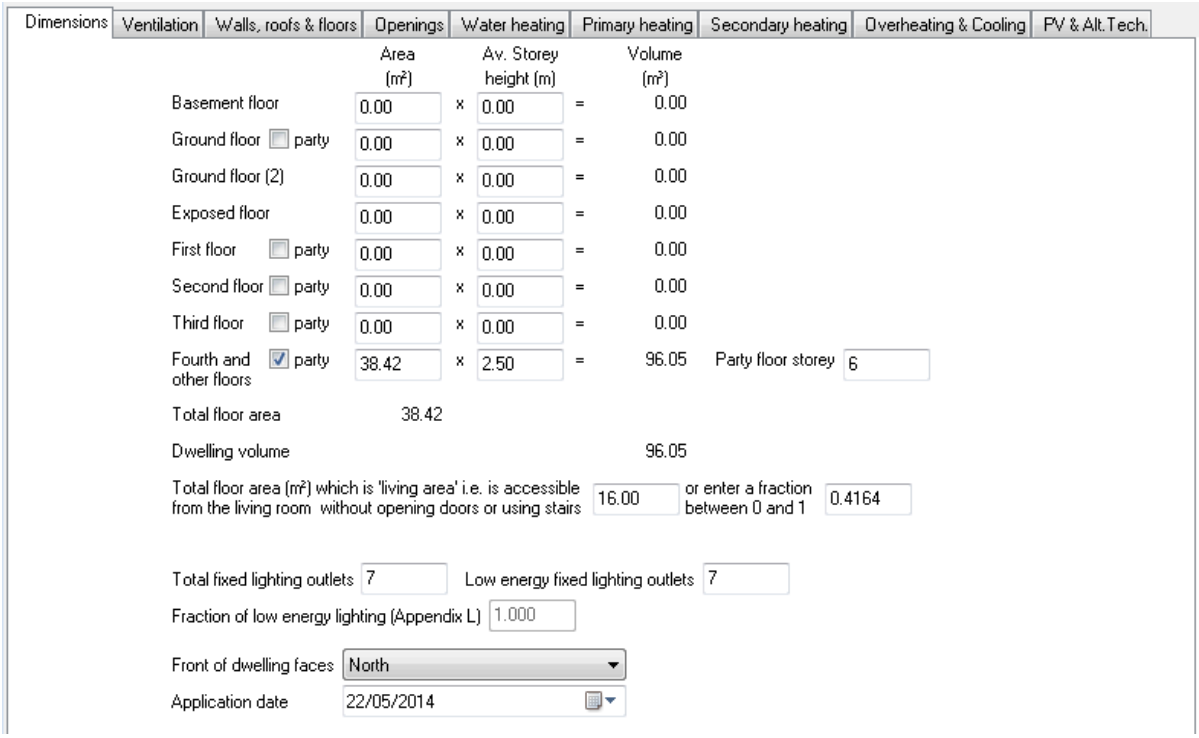

Dimensions
Ventilation
Walls, roofs & floors
Openings
Water heating
Primary heating
Secondary heating
Overheating & Cooling
PV & Alt.Tech.
Area (m²)
Av. Storey height (m)
Volume (m³)
Basement floor 0.00 x 0.00 = 0.00
Ground floor party 0.00 x 0.00 = 0.00
Ground floor (2) 0.00 x 0.00 = 0.00
Exposed floor 0.00 x 0.00 = 0.00
First floor party 0.00 x 0.00 = 0.00
Second floor party 0.00 x 0.00 = 0.00
Third floor party 0.00 x 0.00 = 0.00
Fourth and other floors party 38.42 x 2.50 = 96.05
Party floor storey 6
Total floor area 38.42
Dwelling volume 96.05
Total floor area (m²) which is 'living area' i.e. is accessible from the living room without opening doors or using stairs 16.00
or enter a fraction between 0 and 1 0.4164
Total fixed lighting outlets 7
Low energy fixed lighting outlets 7
Fraction of low energy lighting (Appendix L) 1.000
Front of dwelling faces North
Application date 22/05/2014

Figure 19.1: The Dimensions tab

19.1 Dwelling area and volume

The area and volume of the dwelling each storey are used throughout the SAP calculation, for example, to determine hot water and lighting usage and the rate of heat loss through ventilation.

The calculation requires the *floor area* of each storey and the *average storey height*.

- **Floor areas** are measured to the internal surfaces of the walls bounding the dwelling, and shouldinclude built-in cupboards accessible from the occupied area of the dwelling and all porches and conservatories which are heated and form part of the habitable space. (Exclude porches and conservatories which are unheated and thermally separated from the living space.)
- The **average storey height** for the lowest floor of a dwelling is measured from finished floor surface to ceiling surface. For every other storey, the height is measured from the ceiling of the floor below to its own ceiling. This convention ensures that the volume of the floor structure is included within the calculation. For room in the roof constructions you will need to determine an average storey height.

For each storey enter the **floor area**, in m^2, and the **average room height**, in m), against the appropriate row in the list. JPA Designer will calculate and display the volume of each storey, the total floor area of the dwelling and the total volume of the dwelling. Note that:

- Values must be entered against the appropriate storey. This is particularly important for flats: do not use *ground floor* unless it actually is a ground floor flat. Assigning floor area to the wrong floor will not affect the results of the SAP calculation, but incompatibilities between storey and party floor values will prevent lodgement of the EPC.
- Enter data for storeys on the fourth floor and higher on the final line.
- Where a floor has a different occupancy beneath it (such as another flat, maisonette, or retail unit) tick the **party** box on that row.
- For party storeys on the fourth floor or higher enter the floor number in **Party floor storey**. The storey number is the floor number plus one: for example, the second floor has a storey number of three.
- The two lines for *Ground floors*, allow for dwellings which have a double height lounge.
- The *Exposed floor* line may be used for floors of apartments which are over garages, parking bays or walkways.

19.2 Living area

The SAP 2012 calculation divides a dwelling into two parts:

- the *living area* which is the part of the dwelling presumed to be used most frequently; and,
- the rest of the dwelling.

The living area is defined as the *the room marked on the plan as the lounge or living room, or the largest public room*. The area of other rooms which are not separated from the living room by doors should also be included. However, the living area cannot extend over more than one storey.

Enter the living area, in (m^2), in **Total floor area which is living area**. JPA Designer will calculate the living area fraction.

19.3 Low energy lighting

The proportion of low energy lighting is used in the calculation of electricity consumption for lighting, with a higher proportion of low energy lighting resulting in lower electricity use and a lower DER. The proportion of low energy lighting is also used to test compliance with the minimum efficiency standards for fixed building services, which currently require at least 3 out of 4 light fittings (a fraction 0.75) to be low energy. Enter:

- the total number of lighting units, in **Total fixed lighting outlets**;
- the number of lighting units which count as low energy lighting, in **Low energy lighting units**.

JPA Designer displays the **Fraction of low energy lighting**.

At the design stage, when it is unlikely that the exact number of lighting units will be known, the simplest strategy is to set the total number of units to 10 or 20, then set the number of low energy units to give the correct proportion: 15 out of 20 will give a proportion of 0.75. An accurate value is required for the EPC submission.

19.4 Orientation

The orientation of the dwelling is used with the data on openings for solar gain and overheating calculations.

To set the orientation, select a direction in the **Front of dwelling faces** list:

- For a house, it is usually easiest to treat the elevation containing the front door as the front face.
- For an block of flats it may be better to treat the front of the block as the front face for all flats, rather than setting different front orientations for each flat.

The **Application date** is used in the EPC submission as the date on which the final EPC assessment was performed. Clicking the down arrow will open a calendar.

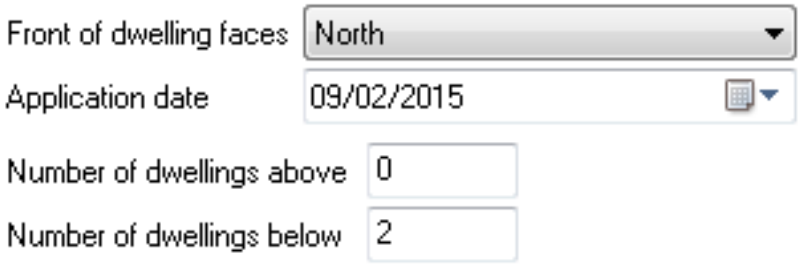


Figure 19.2: Entering position in block for Scotland

19.5 Position in block

The TER calculation for section 6 in Scotland calculates the output of solar panels on the notional dwelling from the roof area of the actual dwelling. For flats and maisonettes that notional output is divided by the total number of dwellings beneath the roof area.In order to carry out this calculation the number of dwellings above and below a flat or maisonette must be entered in the Non-domestic premises in the same building are treated as one dwelling.

When the calculation region has been set to Scotland the **Dimensions**tab includes two addition boxes for the **Number of dwellings above** and **Number of dwellings below** boxes (Figure 19.2). JPA Designer will check the values entered into the two boxes against the definition of the flat or maisonette in the **Project Information** dialogue. It will warn you if the values are incompatible (e.g. a top floor flat with one or more flats above, or a mid floor flat with no flats above).

20 Ventilation

SAP determines the heat loss produced from air movement between the inside and outside of a dwelling by considering:

- air infiltration through the building fabric.
- details of the ventilation arrangements.

Data for air movement is entered using the **Ventilation** tab (Figure 20.1).

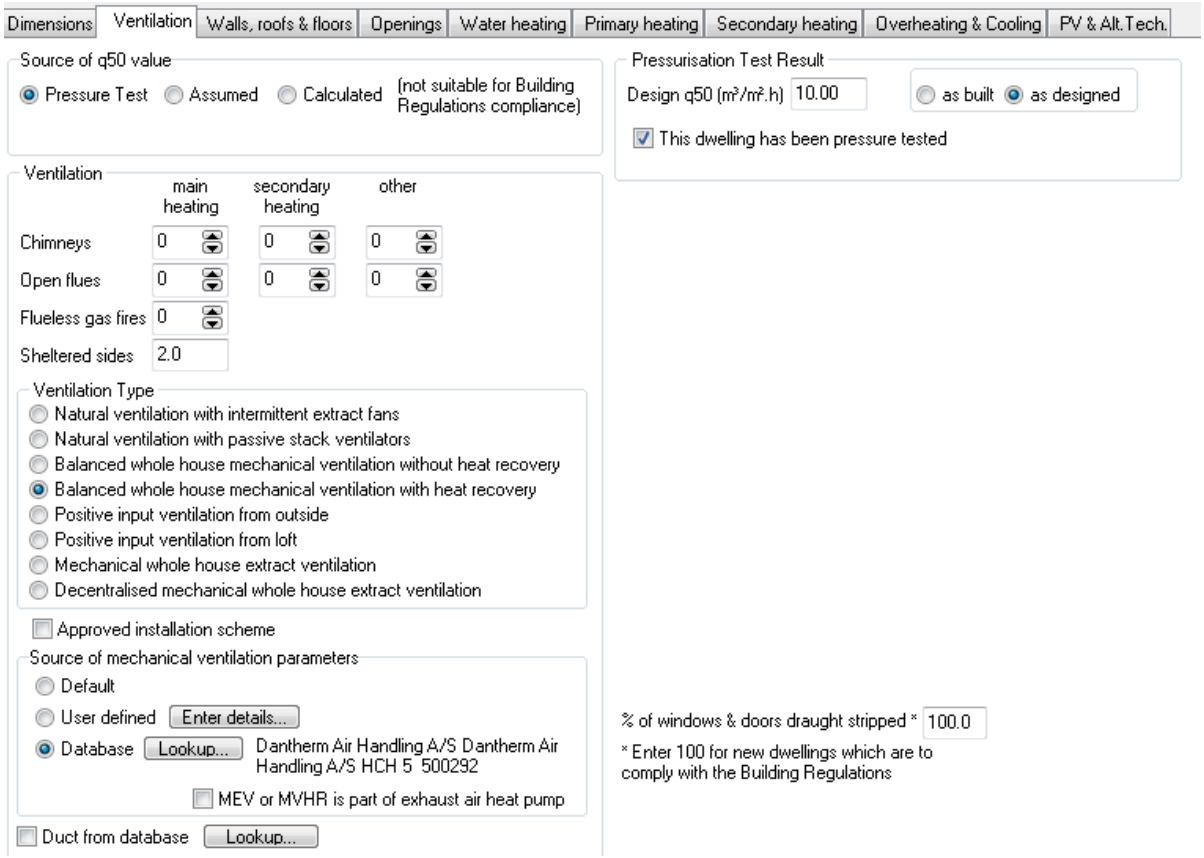


Figure 20.1: The Ventilation tab

20.1 Air infiltration

Air infiltration represents *unplanned* air movement. It is expressed as the volume of air which passes in one hour through a square metre of the surface of the building envelope: m^3/hm^2. The value is is often referred to as the *q50* value, after the calculation result in BS EN 13829.

There are three methods to enter the air infiltration data into the software:

- Using the results of pressure testing.
- On developments of one or two houses, using an assumed value..
- Allow the software to calculate the infiltration rate from the construction type and building size.

  This final method is not valid for demonstrating compliance under building regulations.

Pressure test data

Where air infiltration is being measured by pressure testing, the initial SAP calculation uses a design air permeability value, which is replaced by a final assessed permeability value once the dwelling has been completed.

To enter *design stage* air permeability:

1. At **Source of q50 value** select *Pressure test*.
2. Enter the air permeability in the **Design q50** box.
3. Set the radio buttons to *as designed*.
4. Tick **This dwelling has been pressure tested**.

The pressure testing regime set out in Approved Document L1A requires a proportion of dwellings on any site to be pressure tested[1]. The assessed air permeability used in the *as-built* SAP calculation depends on whether or not the dwelling in question has been tested itself:

- dwellings which have been tested: the assessed air permeability is the result from testing.
- dwellings which have not been tested: the assessed air permeability is the average results for that dwelling type, increased by two.

To enter *as-built* air pressure test data for a tested dwelling:

1. Enter the measured air permeability in the **Design q50** box.
2. Set the radio buttons to *as designed*.

[1] There are similar, but not identical requirements in place for Wales and for Scotland

3. Tick **This dwelling has been pressure tested**.

To enter *as-built* air pressure test data for a dwelling which has not been tested itself:

1. Enter the average air permeability for the dwelling type in the **Design q50** box.
2. Set the radio buttons to *as-built*.
3. Do **not** tick **This dwelling has been pressure tested**. JPA Designer will increase the entered pressure test value in the SAP and DER calculations by two.

Small developments

Pressure testing is not required for developments of one or two houses, provided the DER calculation is carried out using an air permeability of 15 m^3/hm^2:

1. At **Source of q50 value** select *Assumed value*.
2. Tick the **Small development** box, which indicates the dwelling is part of a development of one or two dwellings.

   If you do not tick the box the dwelling will fail its compliance checks.

The **Design q50** box is now fixed at 15 m^3/hm^2.

Using a calculated air permeability rate

Where a dwelling is not subject to the air pressure testing requirements of Part L an air permeability value can be estimated from basic details of the construction and configuration of the dwelling. This is suitable for calculations for existing dwellings to Approved Document L1B.

1. At **Source of q50 value** select *Calculated*. The tab shows additional text boxes.
2. Specify:
   - the Type of construction;
   - whether there is a draught lobby;
   - the floor construction;
   - the number of storeys.

The software then calculates an air permeability rate based on the SAP defaults.

20.2 Ventilation openings

In the **Ventilation** section enter details of the ventilation openings for the dwelling. Use the boxes to enter the numbers of:

- **Chimneys**: vertical ducts for combustion gases with diameter greater than 200 mm.
- **Flues**: vertical ducts for combustion gases with diameter less than 200 mm.

  Chimneys and flues should be assigned to the main or secondary heating systems, or another appliance. There is no need to enter room-sealed and balanced flues to heating appliances, as they do not affect air movement in the occupied space.
- **Flueless gas fires**[2].

20.3 Sheltered sides

The rate of air infiltration resulting from the wind is affected by the number of exposed sides of the dwelling. SAP 2012 therefore adjusts infiltration according to the number of sheltered sides a dwelling has.

A sheltered side is:

- a party wall;
- a side which is sheltered by neighbouring buildings. The exact conditions are described in section 2.5 of the SAP 2012 document.

The number of sheltered sides is entered in the **Sheltered sides** box. If the local conditions are unknown, use a default value of two sheltered sides.

20.4 Ventilation type

There are two steps to defining the ventilation arrangements for the dwelling:

1. Use the **Ventilation Type** radio buttons to specify the type of ventilation in the dwelling (see section 2.6 of the SAP document for details of the different ventilation systems).
2. Specify the details of the system.

For all ventilation systems leave the box **100% draught-stripping** ticked.

The additional performance data for systems that require it can be set in three different ways:

- Use the *Default* performance values built into the SAP specification.

  Although this is a valid option for calculation, the defaults values will give significantly poorer results than the other options.

[2] Although the gas fires themselves are flueless regulations require specific ventilation provision for each appliance which will result in heat loss through air exchange.

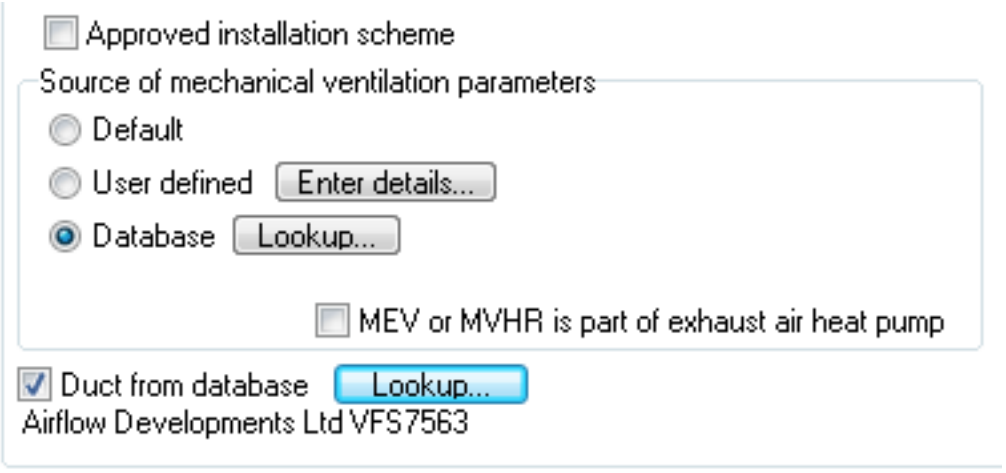


Figure 20.2: Setting the source of mechanical ventilation data

- *User defined*: allows you to enter your own performance values, such as those supplied by product manufacturers.
- *Database*: performance values from the Product Characteristics Data File (PCDF) maintained by BRE.

  The PCDF values should be used wherever possible, as they will be most accurate.

Default performance values

To use default values select *Default* at **Source of mechanical ventilation parameters**. This will give a poor result for the dwelling as the default values are significantly worse than manufacturers' data.

If the ventilation system consists of intermittent extract fans or passive vents in bathrooms and toilets, enter the number of **intermittent fans** or **passive vents**.

Use-defined performance data

To enter user-defined performance data:

1. Select *User defined* at **Source of mechanical ventilation parameters**
2. Click **Enter details**.
3. Complete the details required for the specified system in the **User Defined Mechanical Ventilation** dialogue.

The parameters required for each ventilation type are:

- For balanced whole house mechanical ventilation (Figure 20.3):
  - Brand and model of system;
  - Duct type and whether or not the duct is insulated;

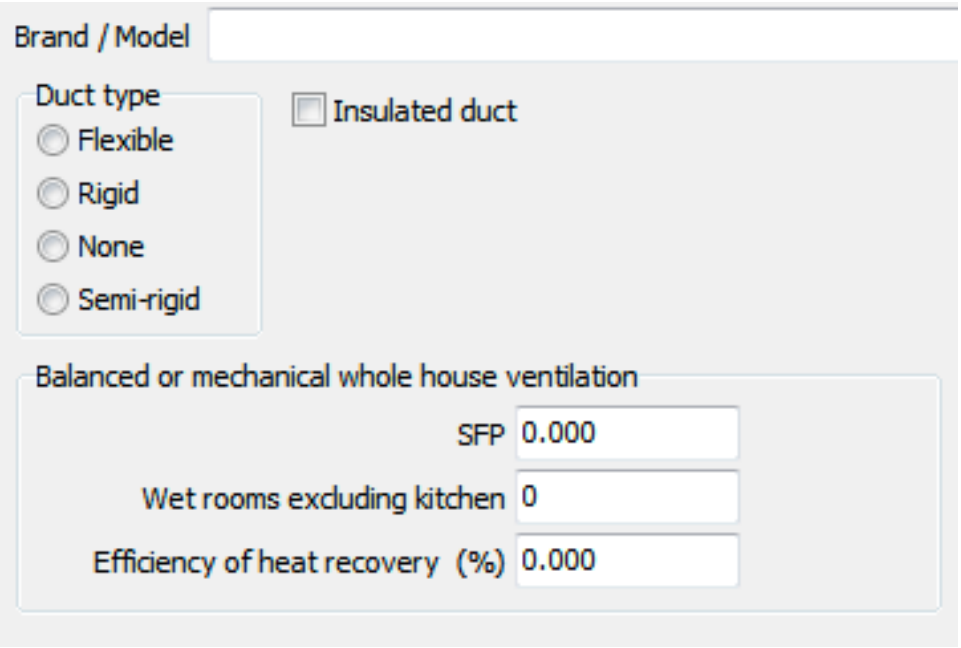


Figure 20.3: User defined data for balanced whole house mechanical ventilation

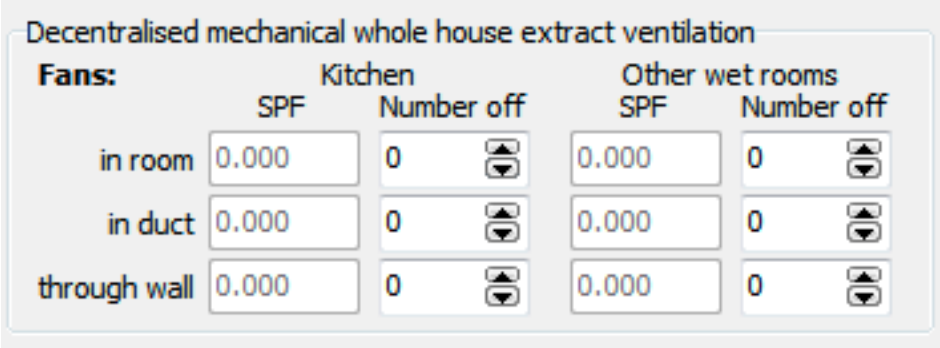


Figure 20.4: User defined data for decentralised mechanical whole house extract ventilation

  - Specific Fan Power (SFP);
  - Number of wet rooms excluding the kitchen;
  - Efficiency of heat recovery.

- For positive input ventilation from outside:
  - The duct configuration.
- For positive input ventilation from the loft:
  - No additional data.
- For centralised mechanical extract ventilation (MEV):
  - The Specific Fan Power (SFP);
  - whether the ducting is rigid or flexible.

- For decentralised mechanical whole house extract ventilation (Figure 20.4:
  - The **Specific Fan Power** (SFP) and number of fans; differentiating between fans in the kitchen and other wet rooms, and between *in room*, *in duct* and *through wall* fans.

Using the Product Characteristics Data File

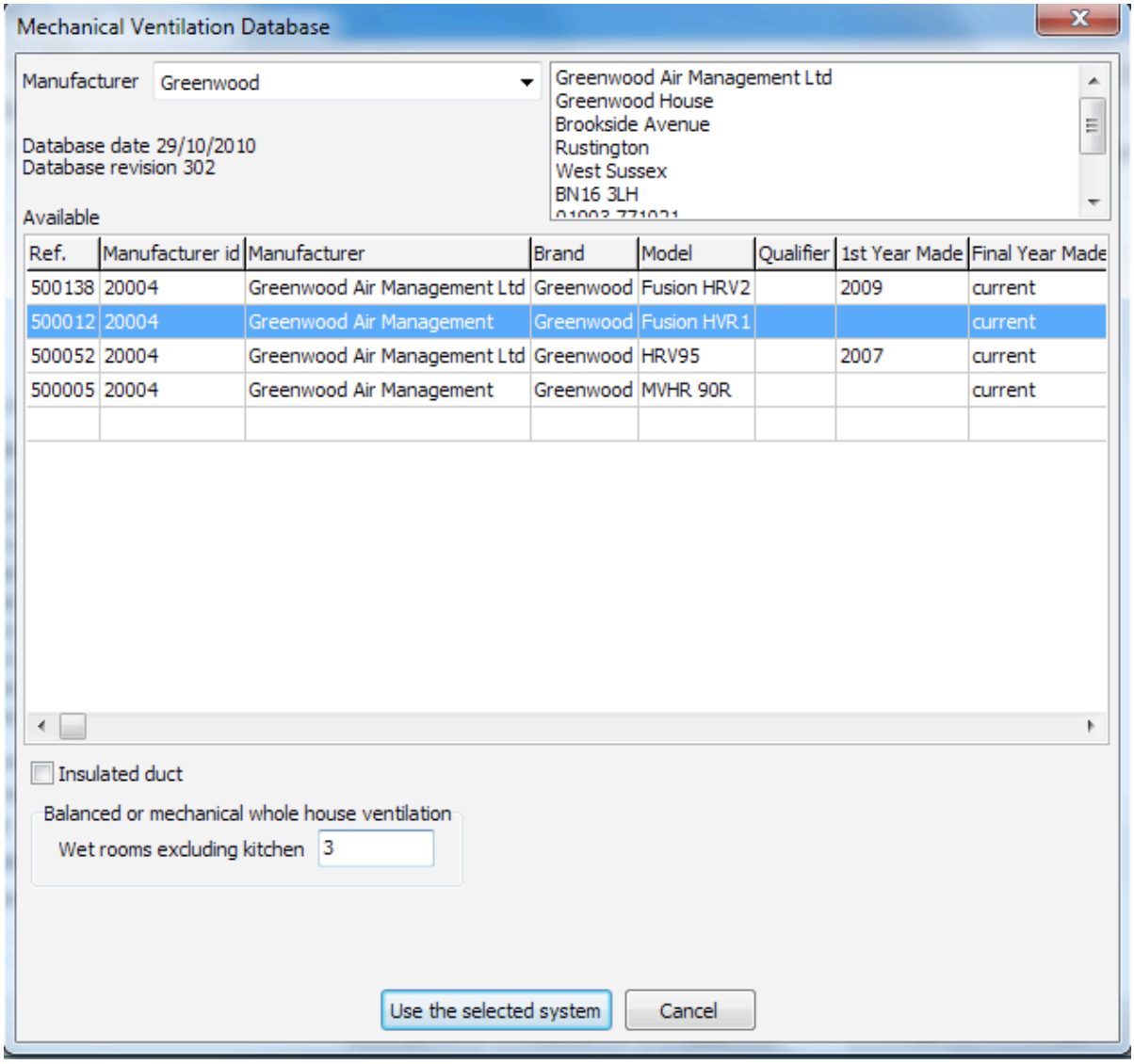


Figure 20.5: The Mechanical Ventilation Database dialogue

To select value from the database:

1. Select *Database* at **Source of mechanical ventilation parameters** .
2. Click **Lookup**.
3. In the **Mechanical Ventilation Database** dialogue (Figure 20.5) select the **Manufacturer**. The list of available products appears.

4. Select a product by clicking on it.
5. Specify the number of **Wet rooms excluding kitchen**.
6. If the ductwork is insulated tick the **Insulated duct** box.
7. For decentralised mechanical whole house extract ventilation, instead of steps 5 and 6, enter the number of fans in kitchens and other wet rooms (Figure 20.4) agains the appropriate fan type.
8. Click the **Use the selected system** button. The dialogue closes and the summary of the system is displayed next to the *Database* radio button.

Ducted systems

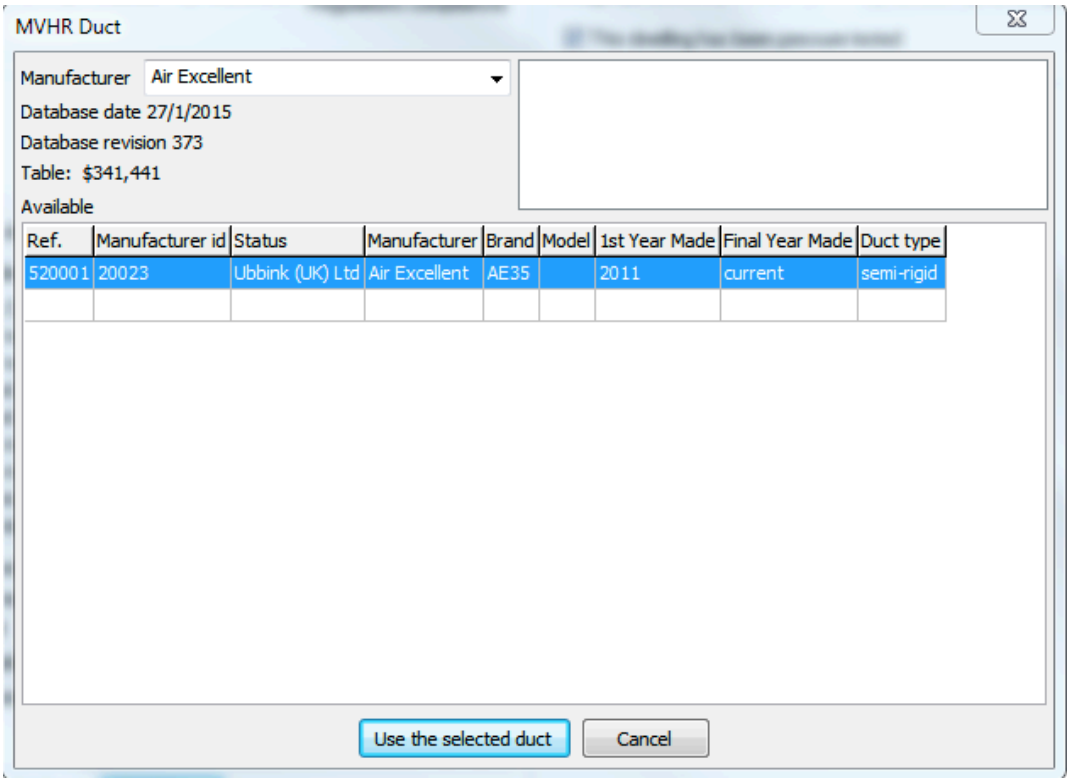


Figure 20.6: The MVHR Duct dialogue

The configuration of ductwork will affect the efficiency of ducted systems, as rigid ducts are more efficient than flexible ducts: this is reflected in the in-use factors for ductwork. Semi-rigid duct should be treated as flexible ducts, unless they have been demonstrated to work as well as rigid ducts and are listed in the PCDF.

To add a semi-rigid duct to the calculation:

- Tick **Duct from database** (Figure 20.2).
- Click **Lookup**. The **MVHR Duct** dialogue opens (Figure 20.6).
- Select the **Manufacturer**.

- Select a duct from the list shown for that manufacturer.
- Click **Use the selected duct**.
- The duct is now shown in the **Ventilation** tab.

Approved installation schemes

Theoretically, a ventilation system fitted under an approved installation scheme will be more efficient than one fitted without quality control. Therefore, ticking **Approved installation scheme** improves the efficiency of a whole house ventilation system. However, at the time of writing (2015–02–11) there is no such scheme in place and there is no reason to tick the box.

21 Walls, roofs and floors

The data on the opaque building fabric — walls, roofs and floors — is used to calculate:

- the rate of fabric heat loss for the dwelling through building elements;
- the rate of heat loss through junctions between elements;
- the thermal mass of the dwelling.

The data is entered using the **Walls, roofs & floors** tab of the **SAP Worksheet values** dialogue (Figure 21.1).

21.1 Defining building elements

SAP 2012 requires data for *all* elements of the building fabric, including:

- Exposed elements which separate the building interior from outside, or from an unheated space, or from an adjacent occupancy with a different heating pattern.
- Party elements which separate the dwelling from another space with a similar heating pattern.
- Internal walls and floors.

The data required for each element depends on its function: the principle items being:

- **Area**: the surface area of the element, in m^2, which should be measured to the boundaries of internal finished surfaces. If you have chosen to use *gross* areas for opaque elements there is no need to subtract the areas of openings from wall or roof areas.

  When adding internal walls, the areas of both sides of the wall should be measured.

- **U-value**: the rate of heat transfer through the element. U-values should be calculated to *BR 443 Conventions for U-value calculations*. The JPA Designer U-value module may be used for this. The requirements for U-values for different elements are summarised in Table 21.2. Note that for party walls between dwellings the U-values must be taken from Table 21.1.
- κ-values (kappa-values): this is the heat capacity of the element, which expresses the amount of energy required to raise its temperature. Table 1e of the SAP document contains additional information about κ-values.

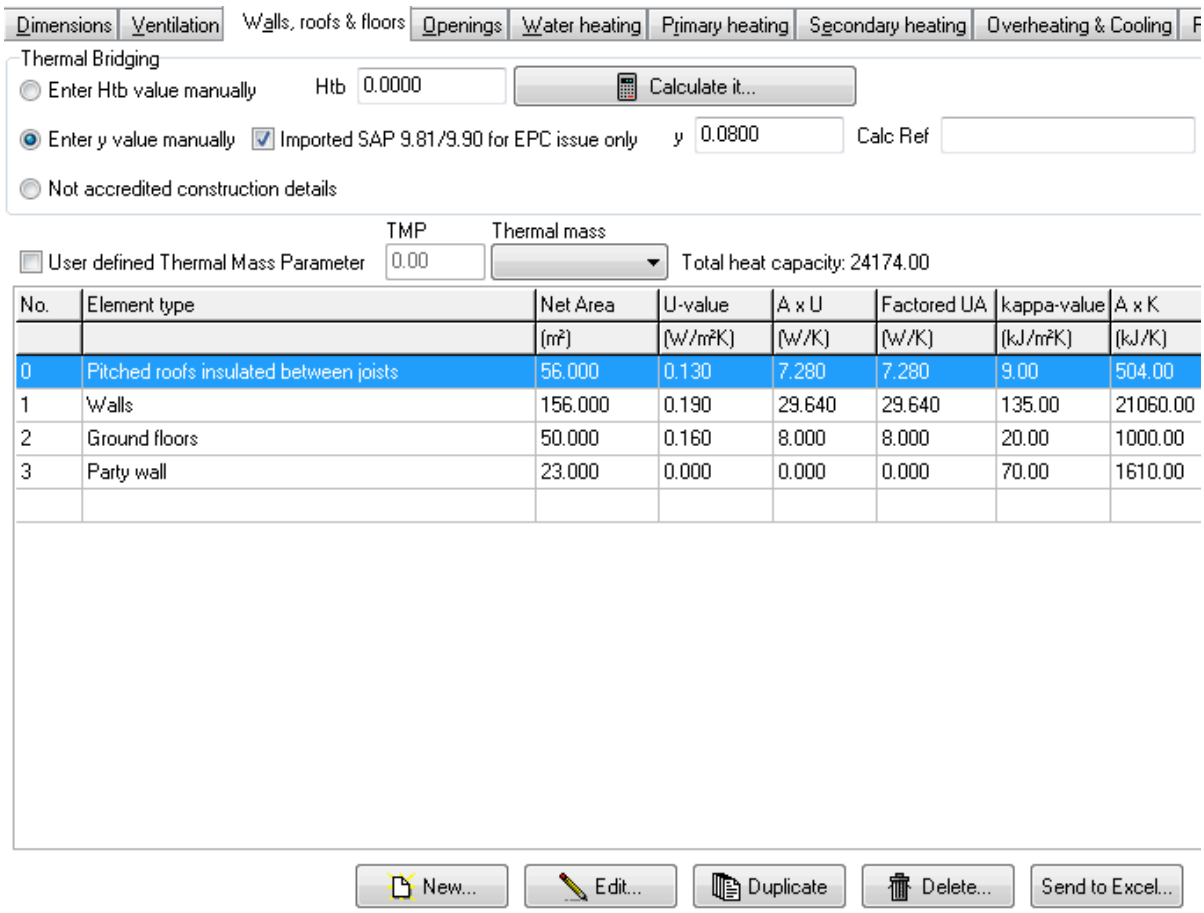


Figure 21.1: The Walls, Roofs and Floors tab

Table 21.1: U-values for party walls

Party wall construction	U-value (W/m^2K)
Solid	0.0
Unfilled cavity with no effective edge sealing	0.5
Unfilled cavity with effective edge sealing	0.2
A fully filled cavity with effective sealing	0.0

Table 21.2: U-values for building elements

Element	U-value	Notes
Exposed element	As calculated	
Semi-exposed	As calculated	Ru adjustment to U-value
Party wall between dwellings	From Table 21.1	
Party wall – similar heating pattern	0.00 W/m^2K	
Party wall – different heating pattern	Half calculated value	
Party floor – similar heating pattern	0.00 W/m^2K	
Party floor – different heating pattern	Half calculated value	
Party ceiling – similar heating pattern	0.00 W/m^2K	
Party ceiling – different heating pattern	Half calculated value	
Internal wall	N/A	Take area of both sides
Internal floor	N/A	
Internal ceiling	N/A	

The Element dialogue

The **Element** Dialogue is used to enter data on each of the dwelling's opaque elements (see Figure 21.2): it takes the following data:

- **Element**: Use the drop-down to set the *type* of element from the list. The element type is used for checking average U-values, so it is important to set the right element type.
- **Curtain wall**: Tick this box if the wall element consists of curtain walling.

  Curtain walling has to be treated differently from normal walls in order to obtain the correct values for heat loss and solar gains. The area of wall should be entered as normal, but the U-value set to that of the whole curtain wall system. The window area should also be that of the whole facade, with the same U-value.
- **Construction**: the drop-down lists a number of common constructions for the specified element type, and offers a quick way of setting the **heat capacity** for the element. Alternatively, you can leave the construction blank and enter the **heat capacity** directly.
- **Party wall type**: this drop-down is only displayed if the **Element** is a party wall.
  - For a party wall between two dwellings select the appropriate construction: that will also set the **U-value**.
  - For a party wall between a dwelling and an occupancy which is *not* a dwelling ignore this box.
- **Storey**: this box is only displayed if the **Element** is a party floor or internal floor. Set the storey number, relative to the building (not just the dwelling) The storey number is the floor number plus one: for example, first floor is storey 2.
- When **Element** is set to *internal floors* the program displays the **Ceiling below** drop-down: select the internal ceiling which forms the other part of the internal floor construction.

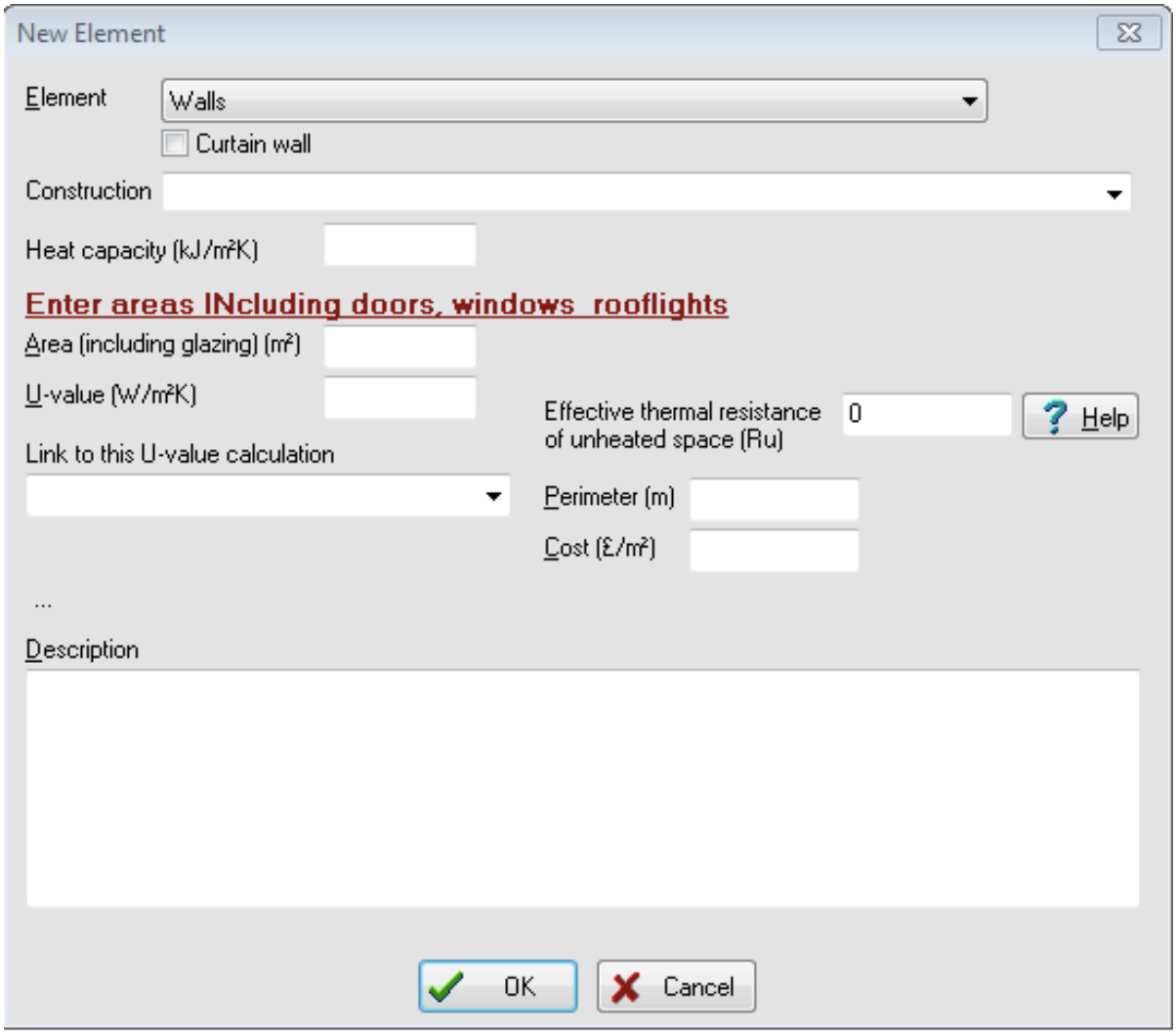


Figure 21.2: ElementDialogue

You should therefore define the internal ceiling elements before you enter the internal floors.

- **Heat capacity**: enter the heat capacity (κ-value) for the element: if you have selected a **Construction** its default heat capacity will already be entered.
- **Area**: Enter the area of the element.

If you have chosen to use gross areas the text above the ***Area*** *box will read* ***Enter areas INcluding doors, windows rooflights****. If it reads* ***EXcluding doors, windows rooflights*** *you must enter net areas.*

- **U-value**: Enter the **U-value** in the text box. If you have already carried out the U-value calculation in the same JPA Designer project you can select it using the **Link to this U-value calculation** drop-down: that creates a permanent link between the element in the SAP calculation and the U-value calculation; the software will update the SAP calculation if the U-value changes.

- **Effective thermal resistance of unheated space (Ru)**: The **Ru** coefficient is used to adjust the U-value of an element to allow for the beneficial effect of an enclosed but unheated space to its exterior. The commonest unheated spaces are integral garages in houses and access corridors to apartment blocks: some parts of room-in-the-roof constructions are also treated as unheated spaces. Click **Select Ru** to open the **Effective Thermal Resistance** dialogue, then pick the garage configuration in the dialogue. Further values for are given in section 3.3 of the SAP documentation.
- **Description**: An optional text description of the element can be entered in the Description text box. A description makes it easier to distinguish between several elements of the same type when editing a calculation.
- **Perimeter** and **Cost**: Ignore these boxes.

Managing building elements

To add a new element:

1. Click the **New** button; the **New Element** dialogue opens.
2. Enter the data for the element then click **OK**. JPA Designer shows the summary data new element in the element list.

To edit an element:-

1. Click the element to edit then click the **Edit** button. The **Edit Element** dialogue opens.
2. Make the changes to the element, then click **OK**.

To duplicate an element:-

1. Select the element to duplicate by clicking on it once.
2. Click the **Duplicate** button. A copy of the element is created.
3. Select the new element and click **Edit** to make changes.

To delete an element:-

1. Select the element to delete by clicking on it once.
2. Click the **Delete** button. A confirm dialogue appears.
3. Click **Yes** to delete the element, or **No** to cancel the deletion.

The summary data on all the elements defined for a dwelling can be exported to an Excel spreadsheet by clicking **Send to Excel**.

21.2 Linear thermal bridging

SAP calculates the heat loss from thermal bridging at junctions between elements, which is usually referred to as **Htb** (heat loss by thermal bridging)[1]. There are three methods of calculating Htb for a dwelling:

1. Calculating the total heat loss from the length and linear thermal transmittance value for each junction type (section 21.2).
2. Use a simplified method based on a calculated **y** factor (section 21.2). **This method is not valid for compliance calculations for new dwellings.**
3. Use a simplified method based on a default **y** factor (section 21.2).

Further information on the treatment of linear thermal bridging can be found in Appendix K of the SAP document.

New in SAP 2012: Thermal bridging at junctions

With SAP 2012 as implemented in Part L 2013 (England), Part L 2014 (Wales) and Section 6 2015 (Scotland) user-defined y-values are no longer permitted.

The Htb calculation

The linear thermal transmittance, or ψ-value (pronounced *psi*-value) for a junction is the rate of heat loss through a one metre length of the junction, measured in units of W/mK. Junctions are categorised as junctions between walls and other elements or components (e.g. windows).
Ψ-values can be obtained from three sources:

1. Where an accredited construction detail[2]is used, you can use the ψ-value which has been calculated for that detail. Table K.1 in the SAP 2012 document lists values for accredited construction details.
2. Where a ψ-value has been calculated for a specific construction detail, by suitably qualified person, you can use that psi-value. That might be a detail supplied by a manufacturer of a construction product featured in the detail.
3. The default ψ-value from the final column of table K.1 in the SAP 2012 document. The defaults are *worst-case* values which represent constructions where little attention has been paid to continuity of insulation or airtightness.

To calculate **Htb** requires the length and ψ-value of each junction in the dwelling. The junction length should be obtained by measurement from the design drawings. It is acceptable to sum the length of separate junctions of the same type, for example, adding together the lengths of all the window jambs.
The data for the Htb calculation is entered using the **Calculate HTB** dialogue (Figure 21.3) which lists all the junction types assigned to the dwelling, showing for each one:

[1]This is heat loss additional to that which happens through the elements.

[2]Accredited construction details for England and Wales are available on the Planning Portal: http://www.planningportal.gov.uk/.
Those for Scotland from the Scottish Government web site: http://www.scotland.gov.uk/Topics/Built-Environment.

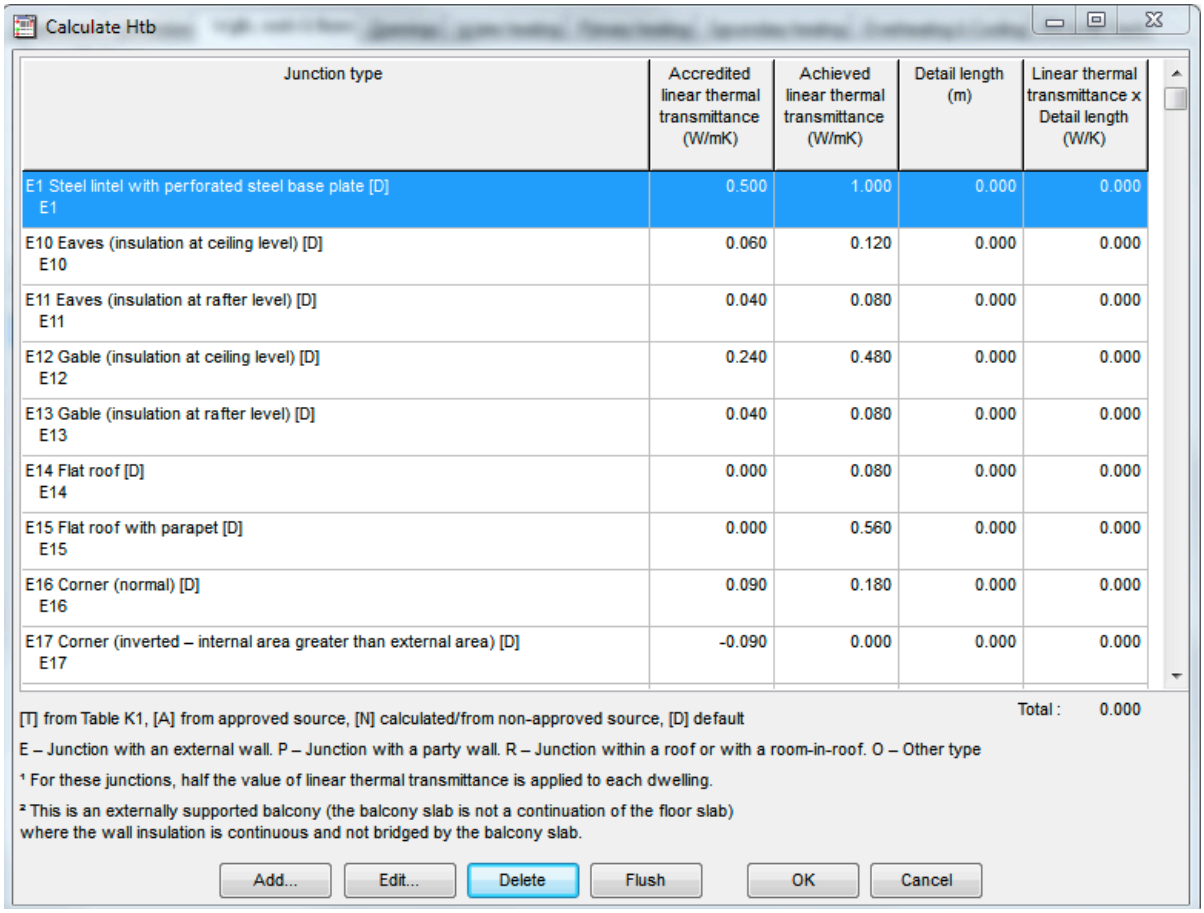

Calculate Htb
Junction type
Accredited linear thermal transmittance (W/mK)
Achieved linear thermal transmittance (W/mK)
Detail length (m)
Linear thermal transmittance x Detail length (W/K)
E1 Steel lintel with perforated steel base plate [D] E1 0.500 1.000 0.000 0.000
E10 Eaves (insulation at ceiling level) [D] E10 0.060 0.120 0.000 0.000
E11 Eaves (insulation at rafter level) [D] E11 0.040 0.080 0.000 0.000
E12 Gable (insulation at ceiling level) [D] E12 0.240 0.480 0.000 0.000
E13 Gable (insulation at rafter level) [D] E13 0.040 0.080 0.000 0.000
E14 Flat roof [D] E14 0.000 0.080 0.000 0.000
E15 Flat roof with parapet [D] E15 0.000 0.560 0.000 0.000
E16 Corner (normal) [D] E16 0.090 0.180 0.000 0.000
E17 Corner (inverted – internal area greater than external area) [D] E17 -0.090 0.000 0.000 0.000
Total : 0.000
[T] from Table K1, [A] from approved source, [N] calculated/from non-approved source, [D] default
E – Junction with an external wall. P – Junction with a party wall. R – Junction within a roof or with a room-in-roof. O – Other type
¹ For these junctions, half the value of linear thermal transmittance is applied to each dwelling.
² This is an externally supported balcony (the balcony slab is not a continuation of the floor slab) where the wall insulation is continuous and not bridged by the balcony slab.
Add...
Edit...
Delete
Flush
OK
Cancel

Figure 21.3: The Calculate Htb dialogue

- the accredited linear thermal transmittance, which represents the ψ-value for the corresponding accredited construction detail;
- the achieved linear thermal transmittance for the junction, which is the ψ-value used in the calculation;
- the length of the detail, in metres;
- the rate of heat loss through the junction, in W/K.

When you first open the **Calculate Htb** dialogue the program adds one of each junction type in the junction list, with the length at zero and the ψ-value set to that of the corresponding accredited detail. The buttons at the bottom of the dialogue allow you to **Add**, **Edit** and **Delete** junctions. The **Flush** button can be removed unused junctions from the standard set.

To use the **Calculate Htb** dialogue:

1. In the **Thermal Bridging** section select *Enter HTB value manually*.
2. Click the **Calculate it** button. The **Calculate Htb** dialogue opens.
3. Edit the **length** of each junction which is found in the dwelling, and adjust the ψ-value if necessary.

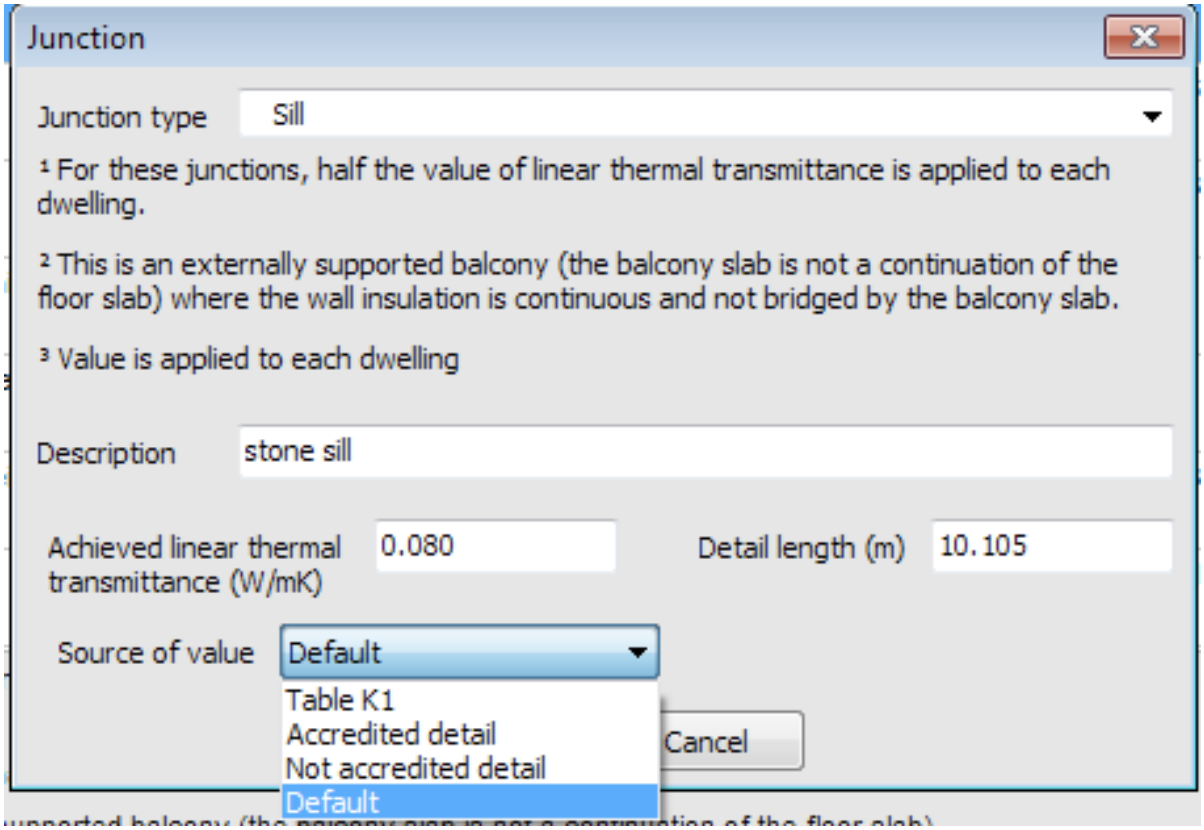

Junction
Junction type
Sill
¹ For these junctions, half the value of linear thermal transmittance is applied to each dwelling.
² This is an externally supported balcony (the balcony slab is not a continuation of the floor slab) where the wall insulation is continuous and not bridged by the balcony slab.
³ Value is applied to each dwelling
Description
stone sill
Achieved linear thermal transmittance (W/mK)
0.080
Detail length (m)
10.105
Source of value
Default
Table K1
Accredited detail
Not accredited detail
Default
Cancel

Figure 21.4: The Junction dialogue

4. Click **Flush** to remove all unused junctions.

To add a junction:

1. Click **Add**. The **Junction** dialogue opens.
2. Select the **Junction type** from the drop-down.
3. Enter a **Description**; this is optional, but adding a description will make it easier to manage the calculation.
4. Enter the **Achieved linear thermal transmittance**: this is the ψ-value.

   The program will offer standard values based on the junction type.
5. Enter the **Detail length**, the total length of the junction, in metres.
6. Set the **Source of value**, which will be one of:

   - *Table K1*: the value for an accredited detail from Table K1 of the SAP 2012 document. The value is based on the junction type and cannot be edited.
   - *Accredited detail*: An accredited detail from a source other than Table K1. This can be used for a detail accredited by a third party scheme.
   - *Not accredited detail*: use this for a calculated ψ-value.
   - *Default*: the value for the non-accredited detail in Table K1. The value is based on the junction type and cannot be edited.

7. Click **OK**. The junction is added to the **Calculate Htb** dialogue.

A report listing the junction data can be included in the calculation outputs (seesection 29.2).

There are two additional points to note when adding junctions:

- there is a distinction between junctions to exposed walls and junctions to party walls: the latter commonly have lower ψ-values.
- if the dwelling has curtain walling there is no need to include the lengths of the window surrounds as the thermal bridging heat losses will have been included in the overall U-value for the curtain wall system.

User-calculated y factor

An approximate value for **Htb** can be obtained by multiplying the total area of the exposed elements (floors, walls and roofs) by a factor, **y**. However, with the introduction of Part L 2013 (England) and Part L 2014 (Wales) *the method is not valid for building regulations compliance for new dwellings*.

The method may be used for dwellings where the original SAP 9.81 or 9.90 calculation has been upgraded to SAP 9.92 in order to lodge an EPC. To use a user-defined y-value:

This procedure may be used where **y** has been calculated for that type and configuration of dwelling. To use a calculated value for y:

1. In the **Thermal Bridging** section select *Enter y value manually*.
2. Tick **Imported SAP 9.81/9.90 for EPC issue only**
3. Enter the value for **y** in the box.
4. Enter a reference for the calculated value of **y** in the **Calc ref** box. The reference must refer to the calculation used to obtain the stated value.

If you choose this option the program will not display the TER worksheet nor the Compliance report.

Default y factor

An approximate value for **Htb** may obtained by using the simplified calculation method with a **y** factor of 0.15: this represents the use of details which are not accredited construction details, and will give a poor result.

To use this method select *Not accredited construction details* in the **Thermal Bridging** section. No other data is required.

21.3 Thermal mass

There are three methods for entering data on the thermal mass of the building fabric:

1. Set the κ-value for all exposed, party and internal elements. The program calculates the thermal mass parameter (TMP) from those values and the areas of those elements; the result is displayed in the **TMP** box.

   This is the most accurate and straightforward method.

2. Enter a TMP value which has been calculated elsewhere. Tick **User defined Thermal Mass Parameter** then enter the value in the **TMP** box.

3. Use one of the three default thermal mass parameters. Tick **User defined Thermal Mass Parameter** then select a thermal mass category from the **Thermal mass** drop down (see Table 1e of the SAP 2012 document for definitions of the categories).

22 Openings

Openings in walls and roofs – windows, doors and rooflights – affect three aspects of the SAP calculation:

- Heat loss: assessed through the U-value.
- Solar gain: assessed through the g window value.
- Daylighting: assessed through the type of glazing.

Data on openings is entered using the **Openings** tab of the **SAP Worksheet Values** dialogue (Figure 22.1). The tab lists the dwelling's windows, doors and rooflights, grouping them according to the building element in they sit. You can enter each opening individually, or you can group the openings on each face of the building into one area, provided they have the same frame and glazing type.

The buttons below the openings list allow you to create, edit and delete openings. For each opening the data is entered using the **Doors, Windows & Rooflights** dialogue (section 22.1).

To define a new opening:

1. In the **Openings** tab click the **New** button. The **New Doors, Windows & Rooflights** dialogue opens.
2. Enter the data for the opening and click **OK**.

To duplicate an opening:

Duplicating an opening creates a new copy of the original opening which can then be edited: as most openings will share the same glazing and frame type, using the duplicate facility can speed up data entry.

1. In the **Openings** tab select the opening you want to duplicate.
2. Click the **Duplicate** button. A copy of the opening is created.
3. Double click on the duplicated opening to edit it.

To edit an existing opening:

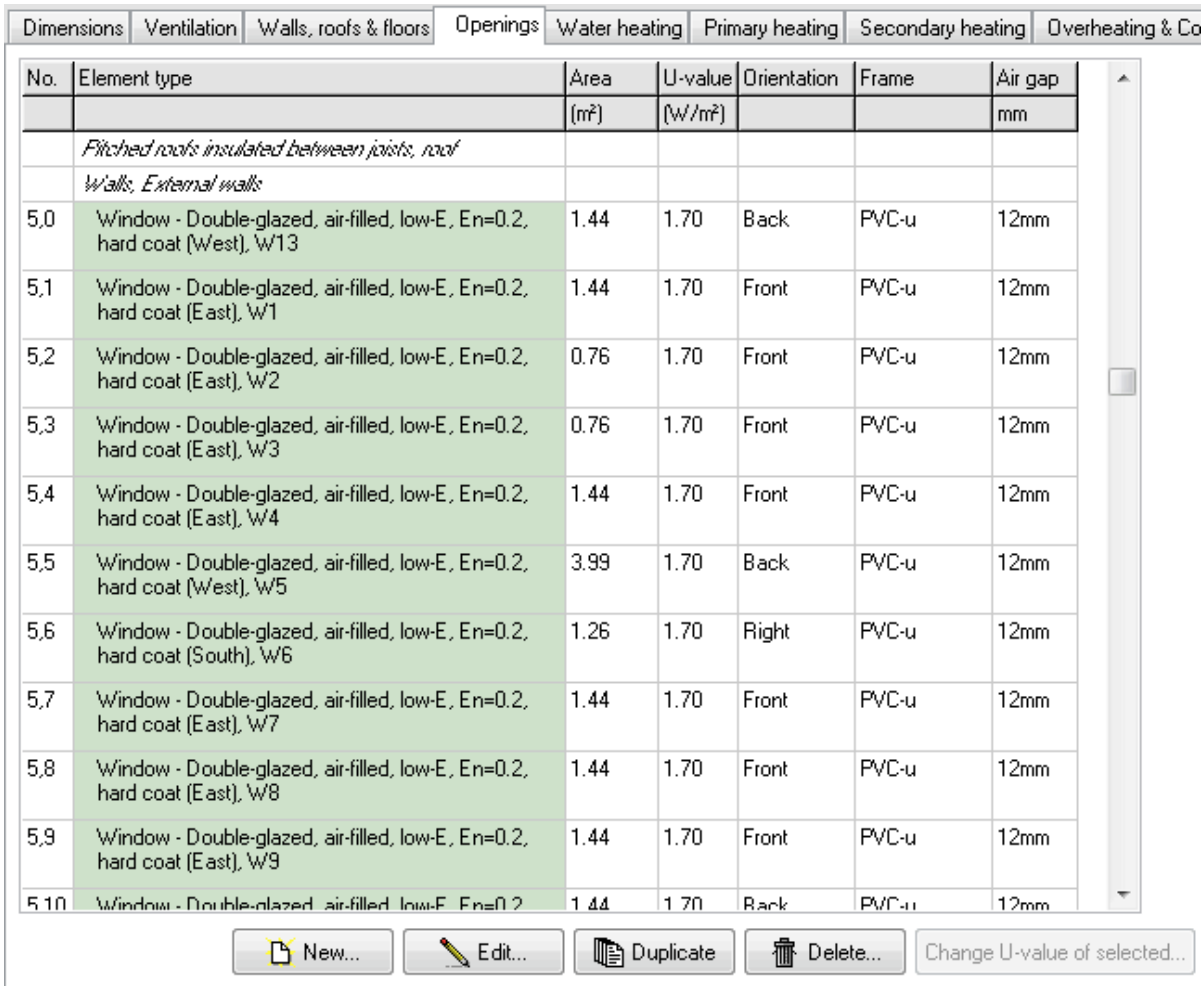

Dimensions
Ventilation
Walls, roofs & floors
Openings
Water heating
Primary heating
Secondary heating
Overheating & Co
No.
Element type
Area (m²)
U-value (W/m²)
Orientation
Frame
Air gap mm
Pitched roofs insulated between joists, roof
Walls, External walls
5,0 Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (West), W13 1.44 1.70 Back PVC-u 12mm
5,1 Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W1 1.44 1.70 Front PVC-u 12mm
5,2 Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W2 0.76 1.70 Front PVC-u 12mm
5,3 Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W3 0.76 1.70 Front PVC-u 12mm
5,4 Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W4 1.44 1.70 Front PVC-u 12mm
5,5 Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (West), W5 3.99 1.70 Back PVC-u 12mm
5,6 Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (South), W6 1.26 1.70 Right PVC-u 12mm
5,7 Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W7 1.44 1.70 Front PVC-u 12mm
5,8 Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W8 1.44 1.70 Front PVC-u 12mm
5,9 Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W9 1.44 1.70 Front PVC-u 12mm
5,10 Window - Double-glazed, air-filled, low-E, En=0.2 1.44 1.70 Back PVC-u 12mm
New...
Edit...
Duplicate
Delete...
Change U-value of selected...

Figure 22.1: The Openings tab

1. Double click on the opening in the list in the **Openings** tab. The **Edit Doors, Windows and Rooflights** dialogue opens (alternatively, you can select the opening then click the **Edit** button).
2. Make your changes then click **OK**.

To delete an opening:

1. Select the opening in the list in the **Openings** tab.
2. Click the **Delete** button. A confirmation dialogue appears.
3. Click **Yes** to delete the opening, or **No** to retain it.

To change multiple U-values:
This function enables you to revise the U-values of several openings at once.

1. Select the first of the openings by clicking on it once.
2. Hold down the <Shift> key and click the last of the openings. That opening, and all the openings between the first and last are now selected.

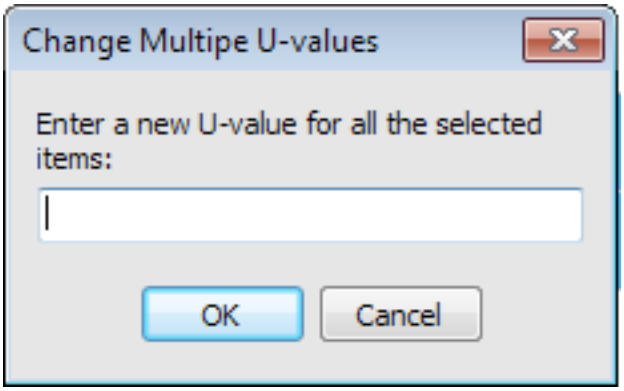


Figure 22.2: Changing the U-values of several openings at the same time

3. Click the **Change U-value of selected openings** button. The **Change Multiple U-values** dialogue opens (Figure 22.2).

4. Enter the new U-value then click **OK**. The U-values are changed.

You can also export the summary data for all openings to an Excel spreadsheet by clicking **Send to Excel**.

22.1 Adding and editing openings

The **Doors, Windows & Rooflights** dialogue (Figure 22.3 is used to enter the data about the openings within the dwelling: the dialogue is headed either *New Doors, Windows & Rooflights* or *Edit Doors, Windows & Rooflights*). The dialogue requires the following data:

- **Opening Type**: Use the drop-down to select whether it is a window, rooflight or door.

- **Opening within**: Use the drop-down to select the element (wall, roof) which contains the opening. The software uses this information to calculate the net areas of the elements. The elements offered in the drop-down will only be those appropriate for the **Opening type**.

  *For example, if you have set the **Opening type** to **Window**, the **Opening within** drop-down will show only walls. Similarly, if you chose **Rooflight**, then **Opening within** will show only roof elements.*

- **Glazing**: Use the drop-down to select the type of glazing, considering the number of leaves of glass, the gas within the cavity or cavities and any low emissivity (low-E) coating.

  Even if you go on to enter a manufacturer's U-value and/or g window value you must still make a selection here to set the correct parameters for daylight.

- **Double-glazing air gap**: Use the radio buttons to select one of the default values or enter your own value. If the gap is greater than 16 mm select **Other** and enter a width in the box.

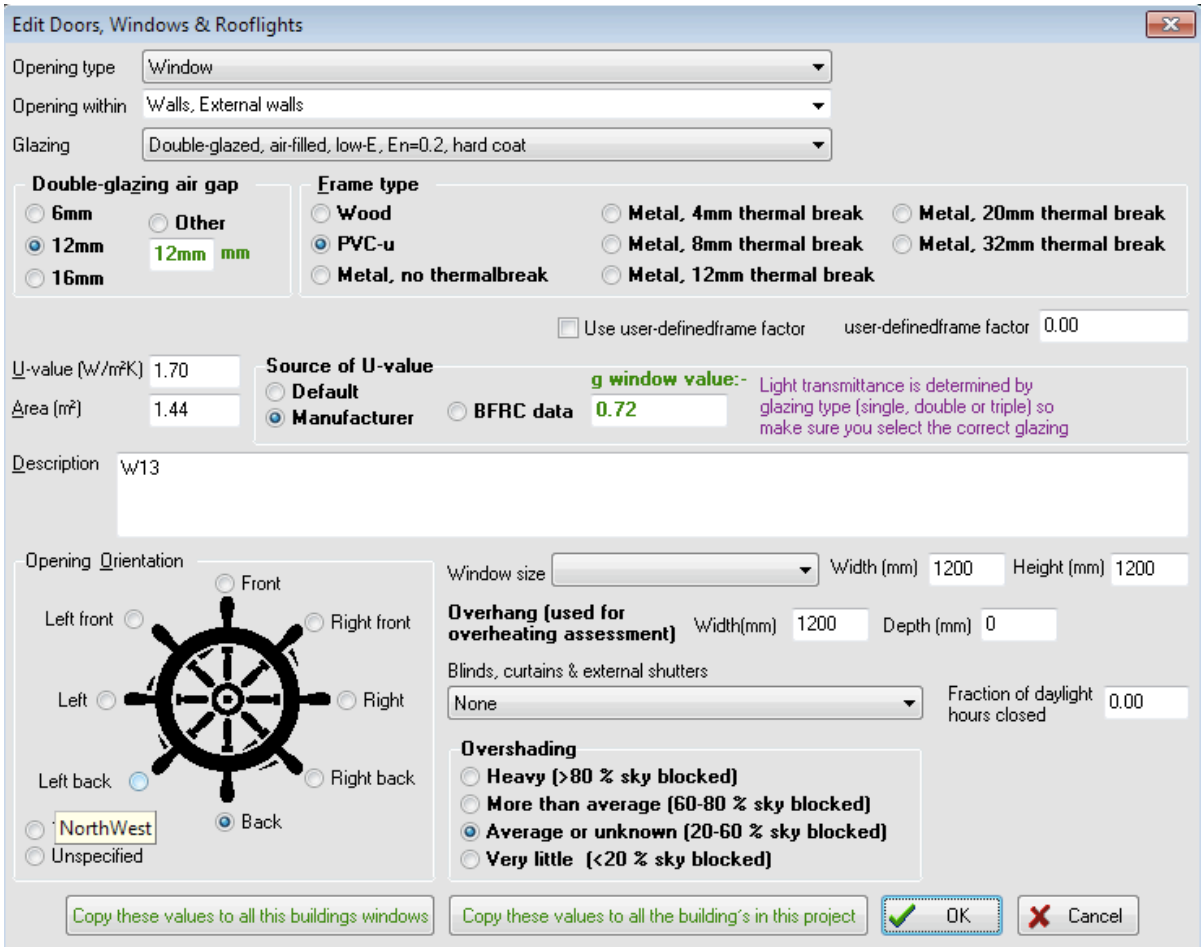


Figure 22.3: The Edit Doors, Windows \& Rooflights dialogue

- **Frame type**: Use the radio buttons to select the frame material and, for metal frames, the depth of the thermal break.
- **Source of U-value**: there are three configurations for the U-value and g window values:
  - *Default*: the software will use the built-in values for the U-value and solar transmittance based on the glazing, double glazing air gap and frame type selection.
  - *Manufacturer*: you should enter a U-value for the opening, but the solar transmittance will be based on the glazing and frame type. *BFRC data*: you should enter a U-value and solar factor (g window value). The g window value must be certified by the British Fenestration Rating Council.
- **U-value**: If **source of U-value** is set to *Default* this box will be greyed out. Otherwise enter the manufacturer supplied U-value.
- **g window value**: Only enter a g window value in here if it is BFRC certified, otherwise leave the default value.

- **Area**: You can enter the opening area directly into the **Area** box, or you can select a size from the **Window size** drop-down, or you can enter the **Width** and **Height** of the opening.

  *Note: the **Area** is entered in metres square, but the values for **Width** and **Height** are entered in millimetres (mm). Where there is an overhang above the window you should use the **Width** and **Height** boxes, to ensure the software correctly takes account of the overshading in the summer overheating calculation.*

- **Description**: The Description box allows you to enter a text description for the element. The description does not affect the outcome of the calculation. If you have set the source of U-value to *manufacturer* or *BFRC* you must enter a description.

  We strongly recommend you use the description box to enter a short description for every opening, such as its number on the window and door schedule: it is much easier to keep track of openings in the calculation when you have a description.

- **Opening orientation**: The direction in which the opening faces determines how much light it will receive and will therefore affect how much solar flux will pass through the opening. The orientation of an opening is set relative to the front elevation of the dwelling: usually that which contains the front door. Set the orientation using the radio buttons. Rooflights always face *Top*. If you are unsure which way the building will be facing then select *Unspecified*.

  *Make sure the **Front** elevation here is the same one you selected in the **Building faces** drop-down in the **Dimensions** tab.*

- **Overhang**: Features such as overhanging balconies or *brise soleil* will reduce the amount of sunlight falling on an opening in summer, and so reduce the solar gain. Where there is an overhang enter its **Width** and **Depth**, both in mm. The depth is measured from the outer edge of the overhang to the external face of the glazing.

- **Blinds, curtains and external shutters**: These will reduce the amount of solar gain and the risk of overheating in summer. Use the drop-down to select the type of shading and then set the **Fraction of daylight hours closed**.

  Appendix P of the SAP documentation gives some guidance of reasonable assumptions for these occupant-determined values.

- **Overshading**: The extent to which the sky is obscured by trees and neighbouring buildings will determine the amount of sunlight and solar flux passing through the glazing. Set the degree of overshading using the radio buttons. Select *Average or unknown* if you cannot establish the amount of overshading. The SAP guidance disallows the use of the *Very little* overshading category for new dwellings as it does not take account of conditions likely to apply over the whole life of the building.

22.2 Editing multiple openings

Changing the specification for openings once they have been added to a calculation can be a time consuming process. JPA Designer has two tools to make the process quicker, by enabling you to copying certain parts of the window data for one window to other windows in the dwelling or project. The only data items copied to the windows are:

- Glazing.
- Double glazing air gap.
- Frame type.
- g window value.

To copy values between openings:

1. Open one window in the **Edit Doors, Windows & Rooflights** dialogue (Figure 22.3).
2. Adjust the data for the window, if necessary.
3. Click one of two buttons:
   - **Copy these values to all this building's windows**: clicking this button sets the window data for all windows in the dwelling to that the currently viewed window.
   - **Copy these values to all the buildings in this project**: clicking this button sets the window data for all windows in all the dwellings in the JPA Designer project to that the currently viewed window.
4. JPA Designer displays a confirmation dialogue. Click **Yes** to carry out the changes, or **No** to ignore them.

   The operation cannot be un-done automatically.

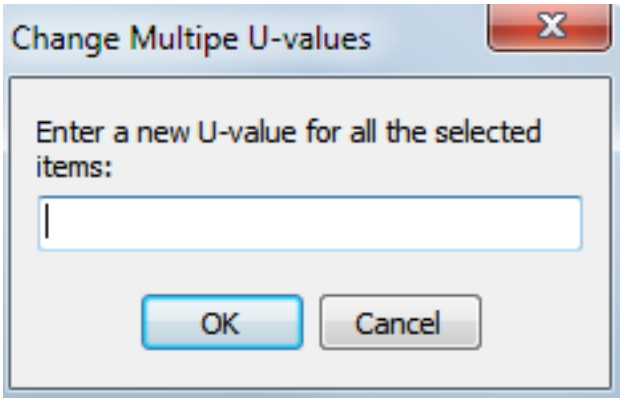


Figure 22.4: The *Change Multiple U-values* dialogue

You can also change the U-values of several openings at the same time, without adjusting any of the other settings:

1. In the **Openings** tab click on the first opening you want to change. Press and hold the <Shift> key then click the last opening to change. Those two openings, and all the ones between will be selected.
2. Click **Change U-value of selected**.
3. In the **Change Multiple U-values** dialogue (Figure 22.4) enter a new U-value and click **OK**. The U-values will be set to the new value.

23 Water heating

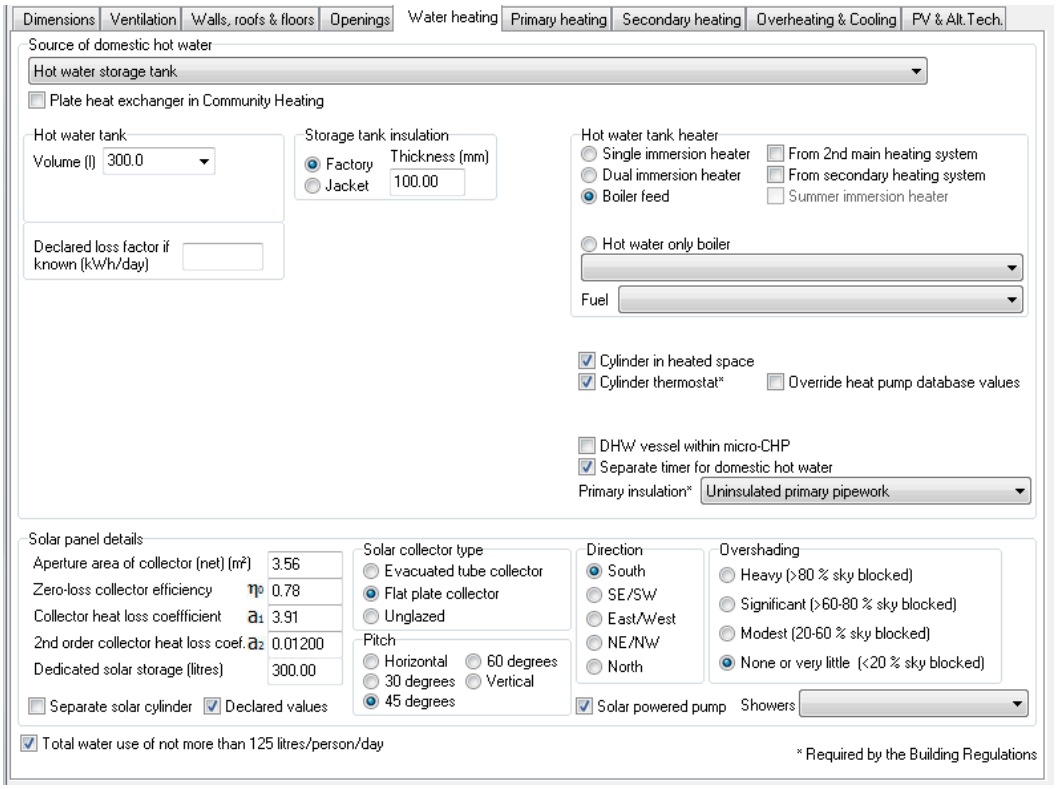


Figure 23.1: The Water heating tab, showing settings for a hot water storage tank

SAP considers the amount of energy used to heat domestic hot water such as that used for bathing, laundry and dishwashing. The demand for hot water is based upon the floor area of the dwelling. Data on domestic hot water is entered using the **Water heating** tab of the **SAP Worksheet values** dialogue (Figure 23.1.

The first step is to select the type of water heating system using the **Source of domestic hot water** drop-box. Once you have made a selection the program will display the appropriate data entry fields. The hot water sources are:

- Hot water storage tank.
- Instantaneous water heating at point of use.
- Combination boiler.

- Community heating scheme.
- Multi-point gas water heater or heat exchange built into a gas warm air system.
- Boiler with thermal store.
- Combined primary storage unit (CPSU).
- MicroCHP or Heat pump.

  Use this option for heat pump with data taken from the Product Characteristics Database (section 24.2. For all other heat pumps use ***Hot water storage tank****.*
- Community heating scheme providing domestic hot water only.

23.1 Hot water storage tank

Select this system for the hot water which is heated by the central heating boiler or immersion coil, then stored in a tank or cylinder ready for use (Figure 23.1). Enter the following data for the tank:

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2012.

The means of heating the hot water must be specified using the **Hot water tank heater** radio buttons:

- *Single electric immersion heater*: a single coil electric immersion heater in the tank;
- *Dual electric immersion heater*: a dual coil electric immersion heater in the tank: this will usually be associated with an off-peak tariff, in which case tick **Off peak electricity immersion heaters**.
- *Boiler feed*: this indicates a heat source which also provides space heating, such as an oil or gas boiler, or a default efficiency heat pump. There are additional boxes to indicate:
  - the hot water is provided by the second main heating system;
  - the hot water is provided by the secondary heating system, which might be a solid fuel room heater with a back boiler;
  - a default efficiency heat pump is supplemented by an immersion heater in the summer.
- *Hot water only boiler*: a dedicated unit which supplies domestic hot water only. Use the drop-down to select the type of boiler, then specify the **Fuel**.

Use the three lower boxes to indicate whether:

- the hot water tank (cylinder) is in the heated space;
- there is a thermostat in the hot water tank (cylinder) (required by Domestic Building Services Compliance Guide);
- the primary pipework between the boiler and tank is insulated (tick box only displayed if boiler feed is selected) (required by Domestic Building Services Compliance Guide;

Use the **Primary insulation** list to specify the extent of insulation to the primary pipework (the pipework between the heat source and the hot water storage vessel).

New in SAP 2012: insulating pipework
The calculation of heat losses from pipework between the heat source and water storage tank or cylinder has been revised. You must now specify the extent of the insulation to that pipework – referred to as the *primary pipework*. Fully insulated pipework will perform best, followed by having all accessible pipework insulated, the first 1m of pipework insulated, while uninsulated pipework has the worst performance.

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 23.10).

23.2 Instantaneous water heating at point of use

For a system which heats the water on-demand at the point of use, you need only select the **Fuel** using the radio buttons.

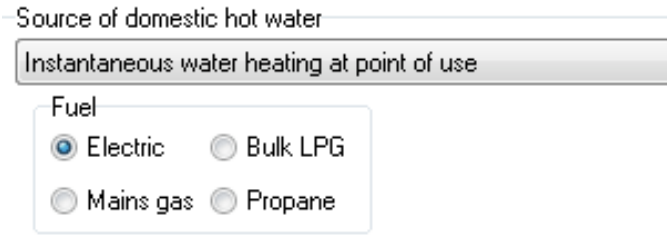


Figure 23.2: Entering an instantaneous hot water heater

23.3 Combination boiler

Combination boilers provide heating and hot water: they may be instantaneous (with up to 15 litres storage), or they may contain small primary or secondary storage tanks (see Appendix B of the SAP 2012 document for definitions). Use the **Combination boiler type** radio buttons to select the type.

If you have selected *Instantaneous* there is no further data to enter. For a boiler with a *primary* or *secondary* store enter the following data:

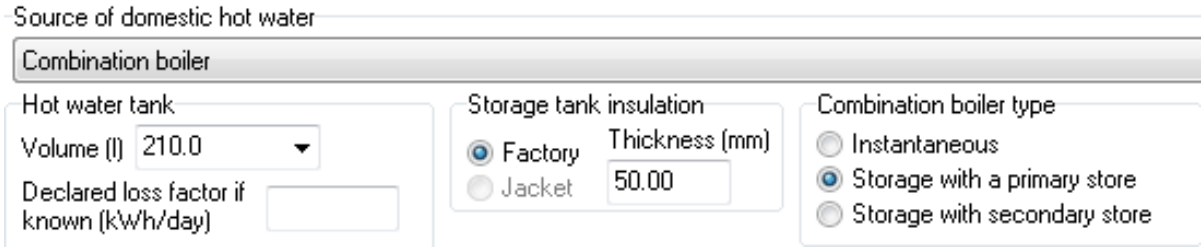


Figure 23.3: Hot water options for combination boilers

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2012.

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (see section 23.10).

23.4 Community heating scheme

The hot water for dwellings heated by community heating schemes can provided by immersion heaters or by a heat exchanger fed from the scheme. In all cases specify the hot water tank heater. There may be additional data required, depending on the configuration of the system:

- Where there is neither a hot water tank nor a heat exchange in the dwelling no further data is required.
- If there is a hot water tank within the dwelling:
  - tick **DHW cylinder within dwelling**;
  - enter the tank details (section 23.1);
  - tick **DHW cylinder within dwelling**;
- If there is no tank and the hot water is provided by a heat exchanger: tick **Plate heat exchanger in Community Heating**;
  - tick **DHW cylinder within dwelling**;
  - enter the volume of the heat exchanger;
  - enter the insulation type and thickness;

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 23.10).

23.5 Multi-point gas water heater or heat exchange built into a gas warm air system

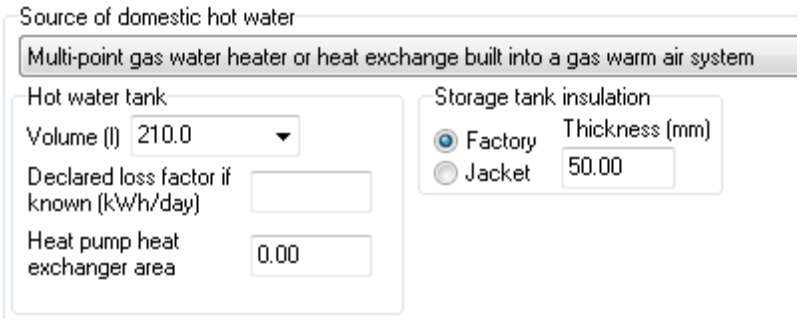

Source of domestic hot water
Multi-point gas water heater or heat exchange built into a gas warm air system
Hot water tank
Volume (l) 210.0
Declared loss factor if known (kWh/day)
Heat pump heat exchanger area 0.00
Storage tank insulation
Factory
Jacket
Thickness (mm)
50.00

Figure 23.4: Data entry for gas water heaters or heat exchangers

This represents systems with one gas-fired water heater providing hot water to a number of outlets, or a water heater which uses a heat exchanger built into a warm air heating system. Enter the following data:

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2012.

Use the three lower boxes to indicate whether:

- the hot water tank (cylinder) is in the heated space;
- there is a thermostat in the hot water tank (cylinder) (required by Domestic Building Services Compliance Guide);
- there is a separate timer for the domestic hot water.

Use the **Primary insulation** list to specify the extent of insulation to the primary pipework (the pipework between the heat source and the hot water storage vessel).

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 23.10).

23.6 Boiler with thermal store

Use this option for thermal stores containing water heated by a separate boiler, with domestic hot water provided by means of heat exchanger within the store.

Enter the following data for the store:

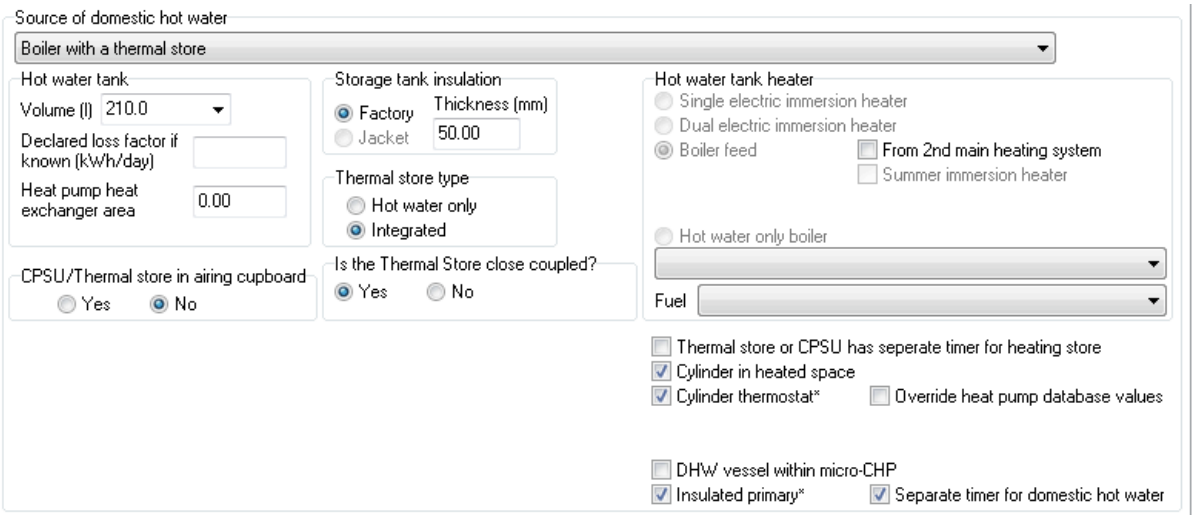


Figure 23.5: Data entry for a thermal store hot water system

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2012.

The hot water tank heater will always be *Boiler feed*.

Use the radio buttons and tick boxes to indicate whether:

- The thermal store is integrated or hot water only.
- The thermal store is in an airing cupboard.
- The thermal store is close coupled.

  Close coupled means the store is either within the same casing as the boiler, or separated from the boiler by no more than 1.5 m *of insulated pipework.*
- There is a separate timer to the thermal store for the heating store.

Use the three lower tick boxes to indicate whether:

- the hot water tank (cylinder) is in the heated space;
- there is a thermostat in the hot water tank (cylinder) (required by Domestic Building Services Compliance Guide);
- there is a separate timer for the domestic hot water.

If the dwelling has solar panels complete the **Solar panel** section of the **Water heating** tab (see section 23.10).

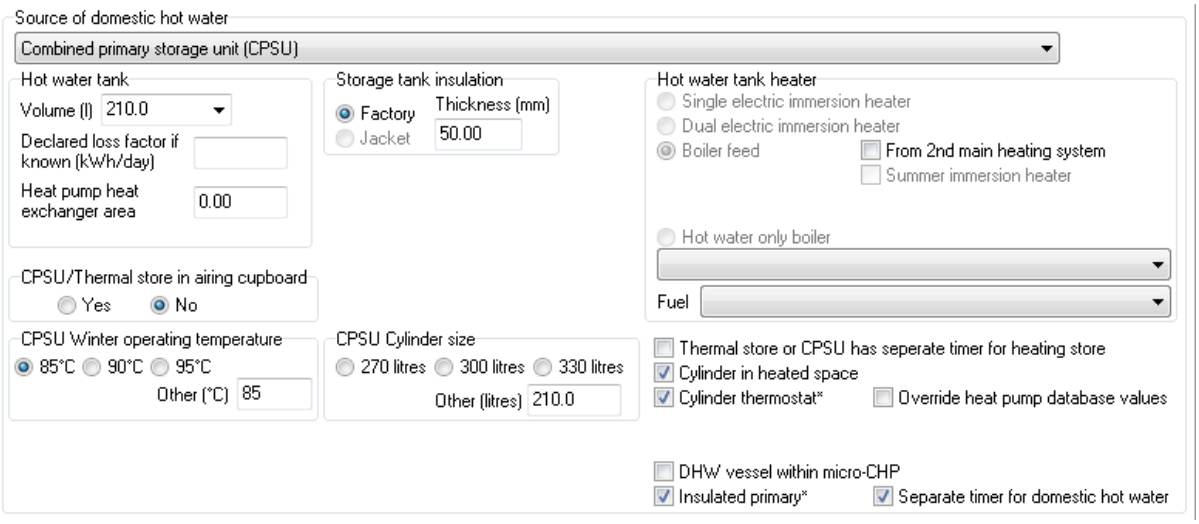


Figure 23.6: Data entry for CPSU hot water supply

23.7 Combined primary storage unit (CPSU)

A Combined Primary Storage Unit provides hot water by means of heat exchanger within the primary store. Enter the following data for the tank:

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2012.

Use the radio buttons and drop-downs to indicate:

- whether the **CPSU is in an airing cupboard**;
- the **winter operating temperature of the CPSU**;
- the **size of the CPSU cylinder**.

Use the lower boxes to indicate whether:

- the CPSU as a **separate timer for the heating store**;
- the hot water tank (cylinder) is in the heated space;
- there is a thermostat in the hot water tank (cylinder) (required by Domestic Building Services Compliance Guide);
- there is a separate timer for the domestic hot water.

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 23.10).

23.8 MicroCHP or heat pump

Use this option for systems in which the hot water is provided either by a domestic-sized combined heat and power (microCHP) system or by a heat pump with efficiency data from the Product Characteristics Database (section 24.2). (If the heat pump has been entered using the default efficiency figures in SAP and *not* the Product Characteristics Database then you should select *Hot water storage tank* as the source of domestic hot water.)

For a microCHP system the only options are whether there is:

- a summer time immersion heater for hot water;
- a hot water vessel within the microCHP system;
- a separate timer for domestic hot water.

For heat pump the standard method is to accept the database values, in which case it is only necessary to specify whether there is:

- a summer time immersion heater for hot water;
- a hot water vessel within the microCHP system;
- a separate timer for domestic hot water.

However, it is possible to override the values by ticking **Override heat pump database values**. The tab now shows the **Hot water tank** data boxes:

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2009.
- **Heat pump heat exchanger area**: Enter the area of the heat exchanger plates in m^2.

If the dwelling has solar panels complete the **Solar panel** section of the **Water heating** tab (section 23.10).

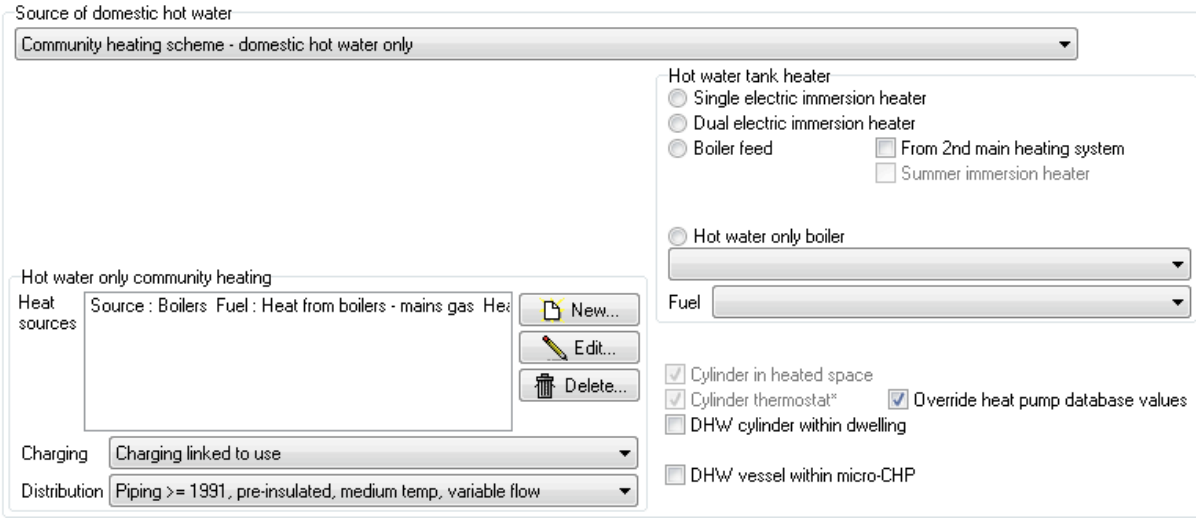


Figure 23.7: Settings for a community heating scheme which supplies only domestic hot water

23.9 Community heating scheme providing domestic hot water only

Use this option for a community heating scheme which provides domestic hot water, but does **not** provide the space heating. Typically, such system are found in flats or sheltered housing.

To specify a system:

- Set the **Source of domestic hot water** to **Community heating - domestic hot water only** (Figure 23.7).
- Set the **Heat Sources** for the system (section 23.9).
- Set the method of **charging** for the hot water supply, using the drop-down: this will either be a flat rate charge for the heating, or will be linked to hot water usage.
- Set the **distribution** method using the drop-down.
- If there is a solar panel linked to the system enter its details (section 23.10).
- If there is a hot water tank or cylinder within the dwelling tick **DHW cylinder within dwelling**: additional data boxes will be displayed for:
- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2012.

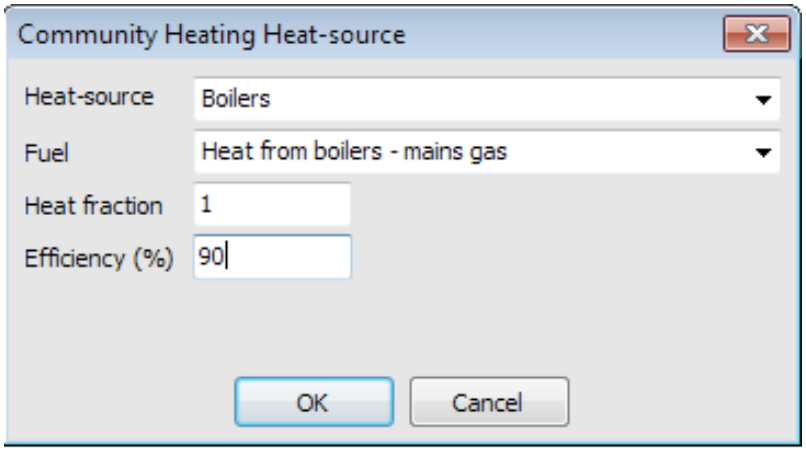


Figure 23.8: Setting a heat source for community heating/hot water

Heat sources

Community heating and hot water schemes can be fed by a variety of heat sources including conventional boilers, heat pumps, combined heat and power systems and even geothermal. The **Heat sources** box lists the sources for domestic hot water (Figure 23.7): sources can be added and edited using the buttons next to the box:

- the **New** button, which opens the **Heat source** dialogue ready for new data;
- the **Edit** button, which opens the **Heat source** dialogue showing the selected heat source.
- the **Delete** button which removes the selected heat source.

The **Heat Source** dialogue (Figure 23.8) requires:

- the type of heat source, selected from the **Heat source** drop-down.
- the fuel, selected from the **Fuel** drop-down.
- the proportion of the total energy load provided by that source. Enter a fraction between 0 and 1 in the **Heat fraction** box.
- the efficiency of that heat source. Enter as a percentage in the **Efficiency** box.

  For most sources the efficiency will be less than 100, but for heat pumps the efficiency may be considerably higher.

23.10 Solar panels

Solar panels use sunlight to pre-heat water for the domestic hot water system. Guidance on including solar panels in the calculation is given in Appendix H of the SAP documentation. Where possible data from the panel's test certificate should be used.

Where a dwelling has solar panels, specify:

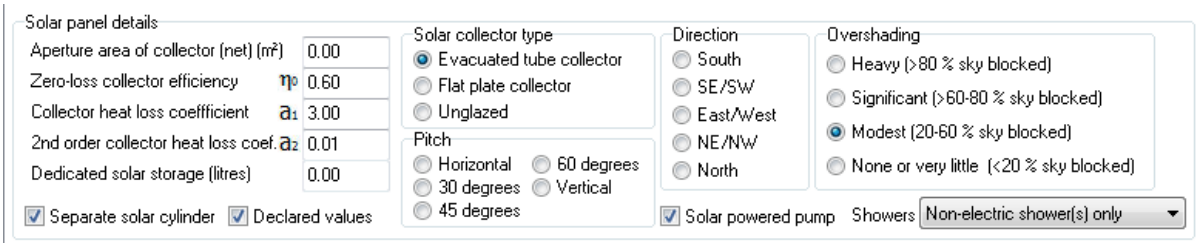


Figure 23.9: Data entry for solar panel water heating

- The net **Aperture area of solar collector**, in square metres.
- The **Zero-loss efficiency of the collector**, η_0.
- The **heat loss coefficient** of the collector, a_1
- The **second order collector heat loss coefficient**, a_2.
- The volume of the **dedicated solar storage**. See figure H2 of the SAP documentation for definitions.
- Whether there is a **separate solar cylinder**.
- The **solar collector type**, using the radio buttons.
- The **pitch** of the panels, measured from the horizontal, and their **orientation**.
- The amount of **overshading** on the panels; generally this will be less than the overshading of windows facing the same direction.
- Whether there is a solar powered pump. This will reduce the amount of electricity used for pumping water.
- The configuration of **Showers**.

New in SAP 2012: solar panels

In SAP 212 the usage of solar hot water is now modified by the configuration of showers in the dwelling. The best performance comes with non-electric showers only, while electric showers only will be worst. SAP 2012 also revised the calculation of output from solar hot water panels and has introduced the *second order heat loss coefficient*, a_2, which improves the accuracy of results for panels with less insulation.

24 Primary heating

The primary heating system is the main heating system for the dwelling, which will often provide hot water as well as space heating; it is usually not based on individual room heaters. Data on the primary heating system is entered using the **Primary heating** tab (Figure 24.1).

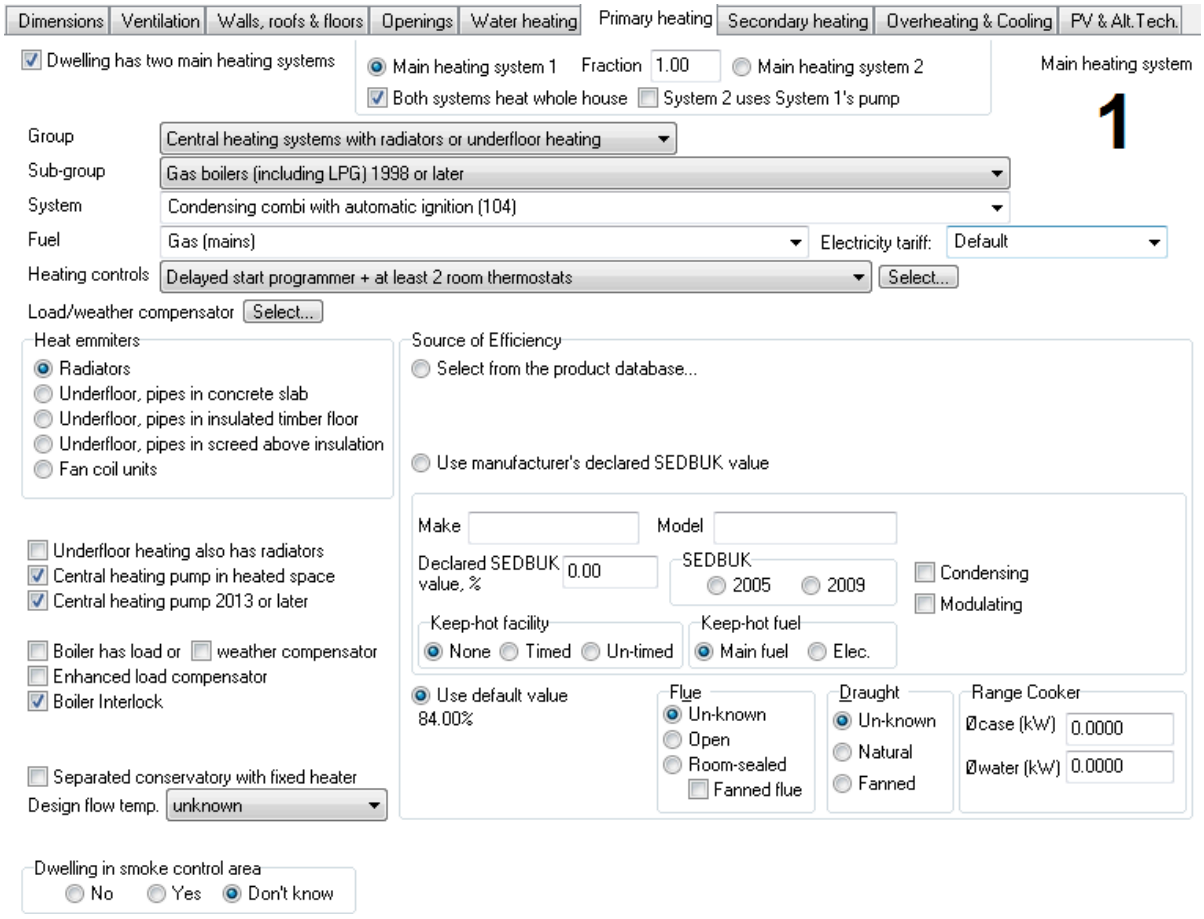


Figure 24.1: The primary heating tab showing two main heating systems

24.1 Dwellings with two main heating systems

SAP 2012 can account for the uncommon case of a dwelling having two main heating systems, which are designed to heat the house together[1]. The two systems may be configured to heat the all the dwelling together, or to heat parts of it separately.

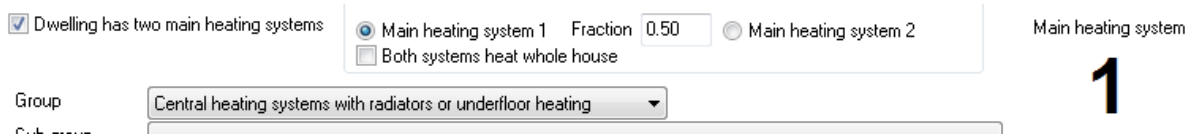


Figure 24.2: Configuring a dwelling with two main heating systems

To specify two heating systems:

1. Tick **Dwelling has two main heating systems**. The program now displays a pair of radio buttons, *Main heating system 1* and *Main heating system 2* (Figure 24.2).
2. With *Main system 1* selected, enter the proportion of the dwelling's space heating demand which is provided by that system in the **Fraction** box (the fraction should be in the range 0.0–1.0).
3. If both systems heat the whole house tick the box **Both systems heat whole house**.

   This affects the treatment of the hot water system.
4. If the systems share the same pump tick **System 2 uses System 1's pump**.

   This affects electricity use and heat gains for pumps.
5. Specify the first system in the **Primary heating** tab.
6. Click *Main system 2* and specify the second system in the **Primary heating** tab.

You can always switch between the systems using the radio buttons: the large number at the top right of the **Primary heating** tab indicates which of the two systems you are working on.

Setting the second system for hot water only

For large houses there may be a dedicated boiler or water heater for hot water. This can be specified in SAP 2012 by setting up two heating systems and assigning the hot water only system as system 2. The fraction for system 1 is then set to 1.00. Then in the **Water heating** tab set the **Source of domestic hot water** to *Hot water storage tank*. In the *Hot water tank heater* section tick **From 2nd main heating system**.

[1] This should not be confused with secondary heating appliances, such as gas fires or wood-burning stoves, which are designed to provide additional heat for individual rooms.

24.2 Efficiency data for heating systems

There are three possible sources of efficiency data for heating systems:

- default values given in Table 4 of the SAP 2012 document.
- data from the Product Characteristics Data File (PCDF, section 24.2): this gives the most accurate values for specific appliances.
- user-entered efficiencies: this can be useful at the design stage when no appliance has been specified. For gas and oil boilers user-entered efficiencies may not be used in as-built' SAP calculations and EPCs: the values must be replaced by PCDF figures.

For some systems (for example, gas-fired warm air systems) only the default SAP 2012 efficiencies may be used, whilst for others (for example, gas condensing boilers) any of the three sources is acceptable. Note that heat pumps can be specified either using the PCDF, or by accepting the default efficiencies: microCHP systems can only be specified by means of the PCDF.

The Product Characteristics Data File

The Products Characteristics Database (PCD) contains performance data for gas, oil and solid fuel boilers, heat pumps, mechanical ventilation systems and some renewable technologies (section 28.4). The database is maintained by the BRE and. A new version of the database is issued at the end of every month.

To ensure you are using an up-to-date version of the database, JPA Designer checks the issue date every time you start the program: if the database is more than a month old the software prompts you to download the latest version. You can prompt a check of the PCDF: on the **File** menu click **Download and re-load Product Characteristics Data File**.

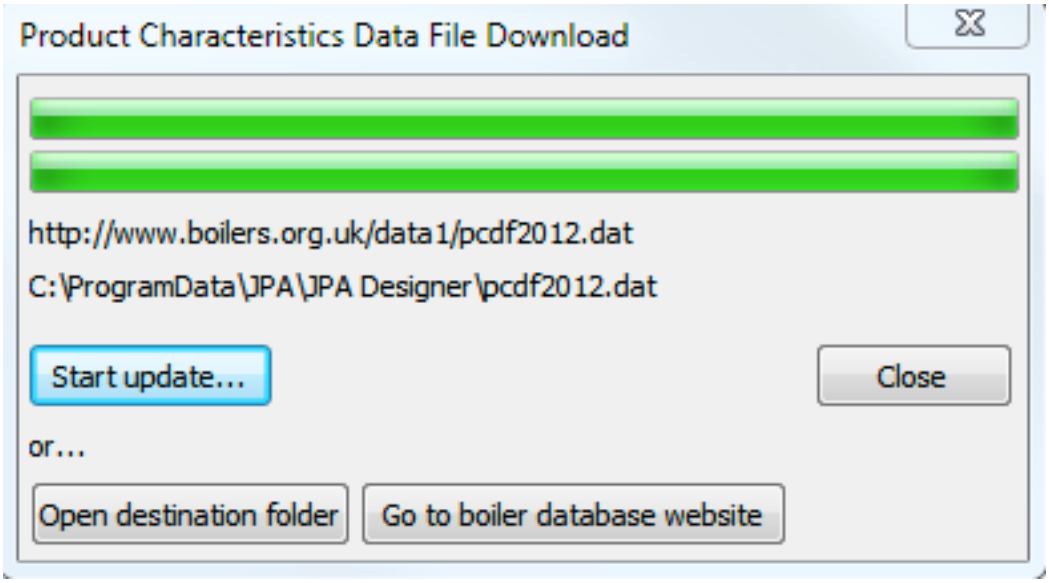


Figure 24.3: Updating the PCDF

The procedure for updating the PCDF is the same for automatic or manual checks:

1. In the **Product Characteristics Data File Download** dialogue click **Start update**. JPA Designer downloads the latest data files for SAP 9.90 and SAP 9.92 and displays an *Update complete* message.
2. Click **OK**.
3. At the information dialogue which asks *Would you like to load the new database* click **Yes**. JPA Designer loads the new data file.
4. Click **Close** to finish the process.

The data in the PCDF can be viewed at http://www.ncm-pcdb.org.uk/sap/

SEDBUK efficiencies

One measure of boiler efficiency used in SAP is the SEDBUK rating (Seasonal Efficiency of Domestic Boilers in the UK). There was a change in the calculation method for SEDBUK efficiency ratings with the introduction of SAP 2009 which resulted in a general lowering of efficiencies. Whilst JPA Designer allows you to enter either 2005 or 2009 SEDBUK ratings, you should be ensure you do not enter a value compatible with the 2005 rating if you have selected the 2009 rating; you may find you have entered a value which cannot be achieved by any boiler in the database.

24.3 The main primary heating systems

There are seven main groups of primary heating system[2]: the following sections describe how to enter data for the each group. In all cases (except community heating schemes), start by using the drop-boxes to set the:

- **Group**;
- **Sub-group**;
- **System**;
- **Fuel**;
- **Heating controls**.

Always work from **Group** downwards, as the options in the lower drop-boxes change according to the selections made higher up. Once you have set all the drop boxes you should enter any other requirements for that group then enter any additional data.

[2] Note that *none* is not an acceptable heating option for a new dwelling.

Heating controls

The heating controls for the primary heating system is set using the **Heating controls** list. The control options listed will depend on the **Group**, **Sub-group**, **System** and **Fuel** settings.

The SAP 2012 document contains descriptions of control options in section 9.4. Broadly speaking, in JPA Designer, the control options towards the bottom of the list will do better than those at the top of the list. For dwellings with a floor area greater than 150 m^2 the heating controls must include time and temperature zone controls.

New for SAP 2012: specifying heating controls

In SAP 2012 it is theoretically possible to select the heating controls from the PCDF (see section 24.2), to give more accurate results. This would be done by setting the **Heating controls** then using the **select** button to the right of the list to open the **Heating Controls Database** dialogue, then selecting the **Manufacturer** and **Model** of controls. At the time of writing (2015 01 07) there are no controls in the database to select.

The efficiency of some heating systems may be improved by load or weather compensators. These may be specified using the **load**, **weather** or **enhanced load compensator** boxes.

New for SAP 2012: specifying compensators

In SAP 2012 it is possible to select the load or weather compensator from the PCDF (see section 24.2), to give more accurate results using the **Load/weather compensator select** button, then in the **Heating Controls Database** selecting the **Manufacturer** and **Model** of controls.

Central heating systems with radiators or underfloor heating

This group covers wet central heating systems with radiators, underfloor pipes, or fan coil units, with the heat can be provided by gas, oil, solid fuel or electric boilers, heat pumps or microCHP units. To specify such systems, set:

- the **Group**, **Sub-group**, **System**, **Fuel**, **Heating controls** and **Electricity tariff**;
- the **Heat emitters**;

  *To combine underfloor heating on the ground floor with radiators on the first floor set the **Heat emitters** to one of the underfloor options and tick **Underfloor heating also has radiators**.*
- the efficiency of the boiler (section 24.3);
- additional items such as heating controls (see section 24.3) and:
  - is the central heating pump in a heated space?
  - is the central heating pump manufactured in 2013 or later? Always tick the box for a new dwelling.
  - for an oil-fired boiler, is the oil pump in the heated space?
  - is there a boiler interlock? That is, the system is installed so the boiler will not fire when there is no demand for heat.

Boiler efficiency

The efficiency of the boiler or other heat source can be entered in one of three ways.

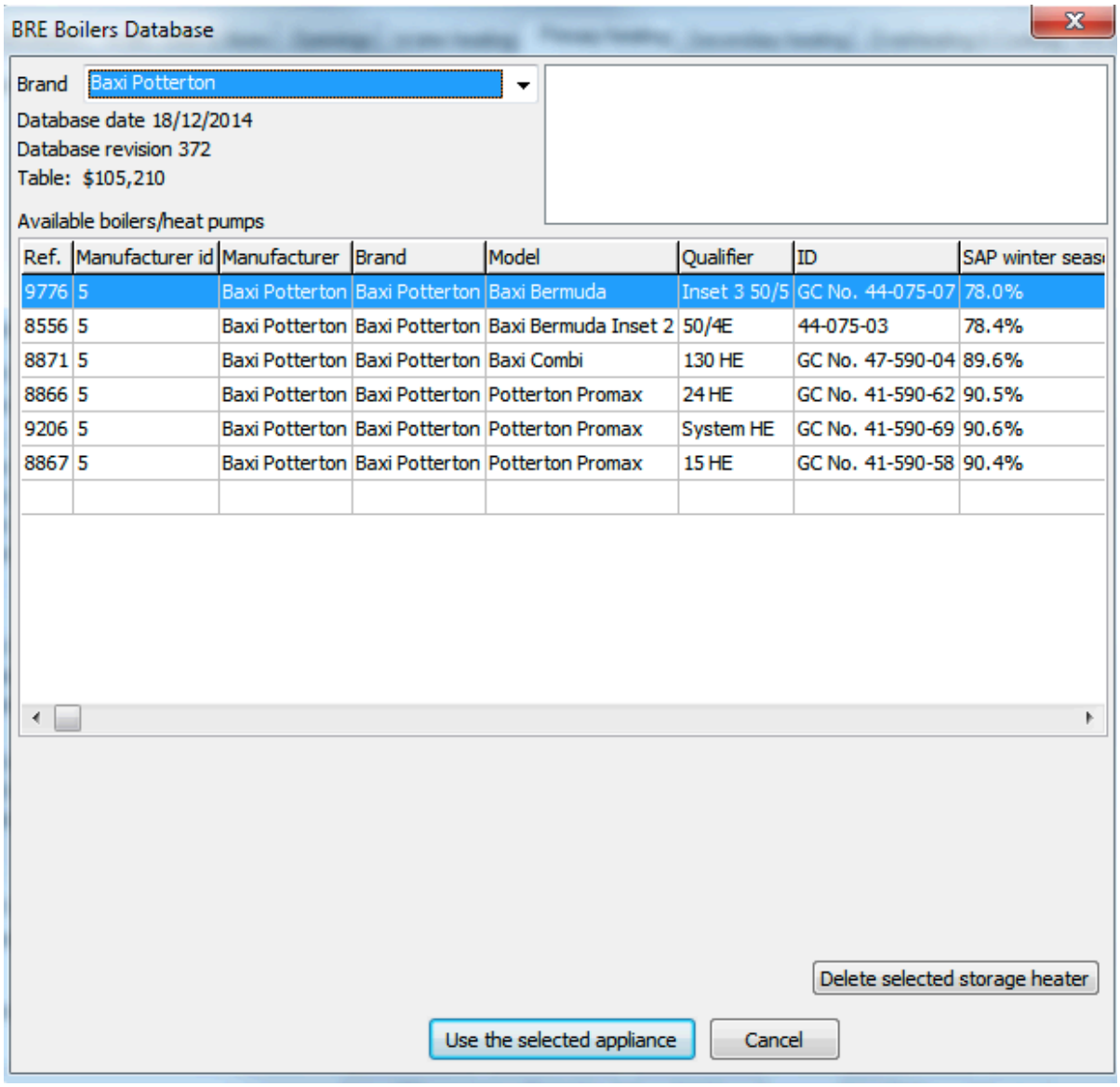

BRE Boilers Database
Brand
Baxi Potterton
Database date 18/12/2014
Database revision 372
Table: $105,210
Available boilers/heat pumps
Ref.
Manufacturer id
Manufacturer
Brand
Model
Qualifier
ID
SAP winter seas
9776 5 Baxi Potterton Baxi Potterton Baxi Bermuda Inset 3 50/5 GC No. 44-075-07 78.0%
8556 5 Baxi Potterton Baxi Potterton Baxi Bermuda Inset 2 50/4E 44-075-03 78.4%
8871 5 Baxi Potterton Baxi Potterton Baxi Combi 130 HE GC No. 47-590-04 89.6%
8866 5 Baxi Potterton Baxi Potterton Potterton Promax 24 HE GC No. 41-590-62 90.5%
9206 5 Baxi Potterton Baxi Potterton Potterton Promax System HE GC No. 41-590-69 90.6%
8867 5 Baxi Potterton Baxi Potterton Potterton Promax 15 HE GC No. 41-590-58 90.4%
Delete selected storage heater
Use the selected appliance
Cancel

Figure 24.4: Using the Product Characteristics Database to set the boiler efficiency

To use the PCDF:

1. Select the *Select from the boiler database* radio button.
2. Click the **Select boiler** button. The **BRE Boilers Database** dialogue opens (Figure 24.4).
3. Select the **Boiler manufacturer** from the drop-down. The program then displays the list of available boilers.
4. Scroll down the list and click on a boiler to select it. You can scroll sideways to view the details of each boiler, such as its efficiency and configuration.

*The program only shows boilers which match the criteria you specified using the drop-downs on the **Primary heating** tab. As a manufacturer does not necessarily offer a boiler in every category the database may not display any boilers.*

5. Click the **Use selected boiler** button. The **Boiler database** window closes and the **Primary heating** tab shows the summary details for the chosen boiler.

   There is no need to enter flue, draught, or keep hot details as all that information is present in the database entry for the boiler.

To enter a SEDBUK value directly:

1. In the **Boiler efficiency** section select the *Use manufacturer's declared SEDBUK value* radio button.
2. Enter the **Make** and **Model** of boiler.
3. Use the radio buttons to specify whether a SEDBUK 2005 or 2009 value is being used and enter the **Declared SEDBUK value**.
4. Specify the type and fuel of any **Keep-hot facility**.
5. Set the **Flue** and **Draught type**.
6. For range cookers you must also enter the values for ϕ**case** and ϕ**water**.

New for SAP 2012: boiler efficiency

It is no longer permissible to use a directly-entered SEDBUK value for final *as-built* calculations for Building Regulations approval. A directly-entered value must be replaced by a boiler selected from the PCDF for the *as-built* calculation.

To use the default value:

1. In the **Boiler efficiency** section select the *Use default value* radio button. The software shows the default value for that boiler type.
2. Use the radio buttons to enter the details of the **Flue** and **Draught type**.
3. For range cookers you must also enter the values for ϕ**case** and ϕ**water**.

Note that the default values are generally too poor to comply with the standards in the Domestic Building Services Compliance Guide.

Storage radiator systems

Storage radiator systems are heated with off-peak electricity during the night and release that heat throughout the day. For most configurations, the only data required is that from the primary heating drop boxes.

New for SAP 2012: high heat retention storage heaters

SAP 2012 has introduced a new category of *high heat retention storage heaters* which can be specified using the PCDF.

To specify high retention storage heaters:

1. Set :
   - **Group** to *Storage radiator systems*;
   - **Sub-group** to *Off-peak tariff*;
   - **System** to *High heat retention storage heaters*;
   - **Fuel** to the appropriate tariff.
   - **Heating controls** to *Controls for high heat retention storage heaters*.
2. At **Source of efficiency** click *Select from the product database*.
3. Click **Select product**. The **BRE Boilers Database** dialogue opens.
4. Select the manufacturer from the **Brand** list.
5. Click on the model then click **Add storage heater to list**.
6. In the quantity dialogue enter the number of that model of storage heaters.
7. If there is another model of storage heater in the dwelling repeat steps 4–6.
   Note there cannot be more than five storage heaters in the dwelling.
8. Click **OK**.

If you need to remove a storage heater from the calculation, select it in the **Selected storage heaters** list then click **Delete selected storage heater**.

Warm air systems

The heat for warm air systems is provided by gas, oil, electricity or heat pumps. For most systems the only data required is that from the primary heating drop boxes.

If you are specifying a warm air system powered by a condensing gas heater or a heat pump it is possible to use efficiency data from the PCDF (see section 24.3 for guidance on the procedure).

Room heater systems

This group includes room heaters such as gas or solid fuel fires[3]. In most cases, the only data required is that from the primary heating drop-boxes. However, where the declared efficiency of the heater is known. tick the box **Use manufacturer's declared efficiency** then complete the **Make**, **Model** and **Declared efficiency** boxes and select the **BS Test Method** used to obtain the efficiency.

Other space and water heater systems

Electric ceiling heating is currently the only system in this category. The only data required is that from the primary heating drop boxes.

Community heating scheme

Community heating schemes use central heat generators to heat water which is then circulated through pipes to supply space heating and hot water to more than one dwelling. The heat may be provided by a number of different systems, and community heating schemes may often include Combined Heat and Power (CHP) systems, which will provide heat and generate electricity. Appendix C of the SAP 2009 document contains further information on the treatment of community heating schemes in SAP.

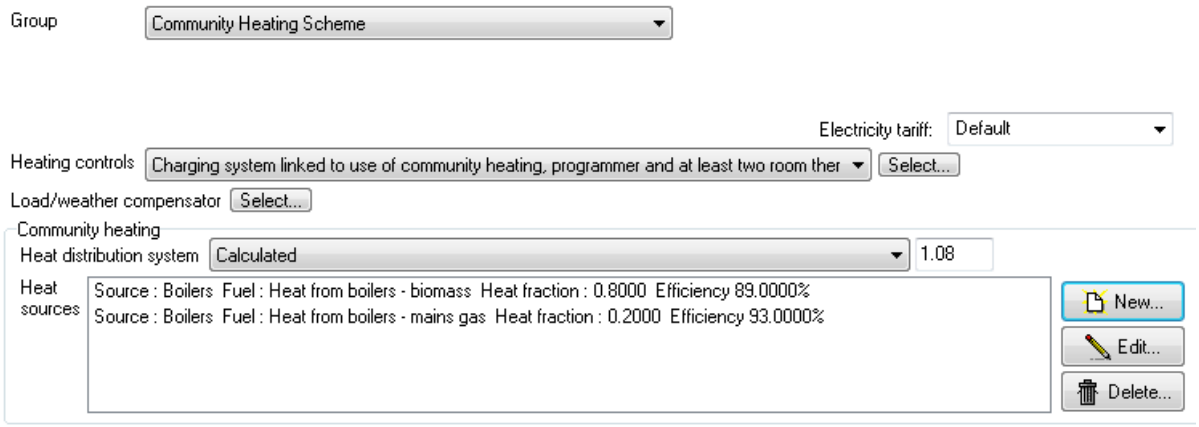


Figure 24.5: Data entry for a community heating scheme with two heat sources

To specify a community heating scheme in JPA Designer:

- set **Group** to *Community heating scheme*. JPA Designer displays the **Community heating** section of the **Primary heating** tab (Figure 24.5).
- set the heat sources;
- set the heating controls;
- set the heat distribution system.

To set the heat sources:

[3]Some of the options will not be appropriate for new-build, but are included for compatibility with the Reduced data SAP (RdSAP) used for EPCs for existing dwellings.

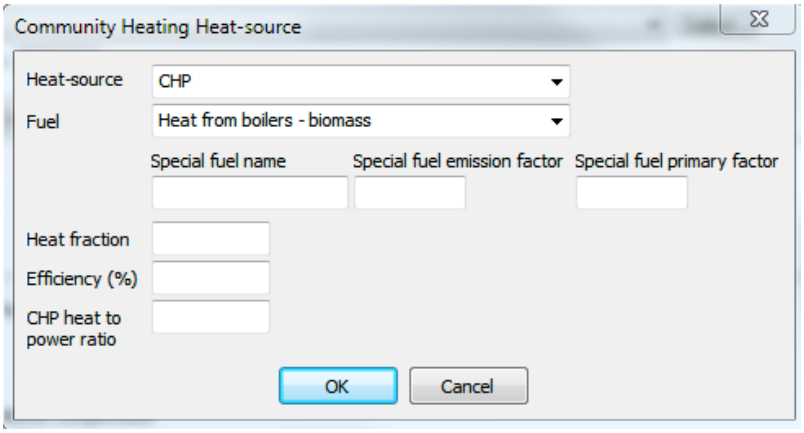


Figure 24.6: Setting a heat source for community heating

- Click the **New** button: the **Heat source** dialogue opens (Figure 24.6).
- Select the type of heat source from the **Heat source** drop-down.
- Select the **Fuel** from the drop-down.

  *When specifying a fuel which is not listed, use the **Special fuel name**, **emission factor** and **primary energy factor** to enter its details.*
- Set the proportion of the total heat load provided by that source: enter a fraction between 0 and 1 in the **Heat fraction** box.

  The total heat fraction from all the heat sources must total 1.00.
- Enter the percentage **Efficiency** of the heat source.

  Note the efficiency should be entered as a percentage.
- For a CHP system enter the heat to power ratio, which will typically be in a range of 1.25–1.5.
- Click **OK** to close the dialogue.
- Repeat the procedure for multiple heat sources: use the **Edit** and **Delete** buttons to adjust or remove heat sources.

To set the controls:

- Set the **Heating controls** and the **Electricity tariff**.

  Systems which rely on flat rate charging will usually be less efficient than those where charging is linked to use.

The heat distribution setting is used to determine the distribution losses for the system. You can either:

- Use a default value based on the type of pipes used to circulate hot water: select the pipe configuration from the **Heat distribution system** list.
- Use a calculated distribution loss factor which is specific to the project (there is guidance on calculating such a loss factor in Appendix C of the SAP 2012 document): select *calculated* from the **Heat distribution system** list, then enter the loss factor in the neighbouring box.

Electric underfloor heating

This option reqpresents underfloor heating systems based on electric cables in the floor slab or integrated into flooring.

The only data required is that from the primary heating drop boxes.

24.4 Additional data

There are two items of additional data which the software collects for producing the EPC which appear on the **Primary heating** tab:

- **Separated conservatory with fixed heater**: Tick this box if the dwelling has a thermally separated conservatory (see SAP guidance section 3.3.3 for the definition of thermally separated) which has a fixed heater within it.
- **Dwelling in smoke control area**: This box is only relevant if solid fuel is set as the fuel for the primary or secondary heating. If the dwelling is within a smoke control zone the use of house coal and dual fuel is not permitted, and wood is permitted for an exempted appliance only. For further information on smoke control areas see http://smokecontrol.defra.gov.uk/index.php[4]. Tick the box if the dwelling is within a smoke control area.

[4]There does not appear to be a central source on smoke control areas: the only means of finding out is to contact the local authority.

25 Secondary heating

A secondary heating system is an additional space heating system for the dwelling: common examples are gas fires or wood burning stoves. Where a secondary system is provided it should be included in the calculation: guidance on when to include a system is given in Approved Document L1A paragraph 2.14. The fraction of space heating provided by the secondary system is defined in table 11 of the SAP 20012 document. Data on secondary heating is specified using the **Secondary heating** tab (Figure 25.1).

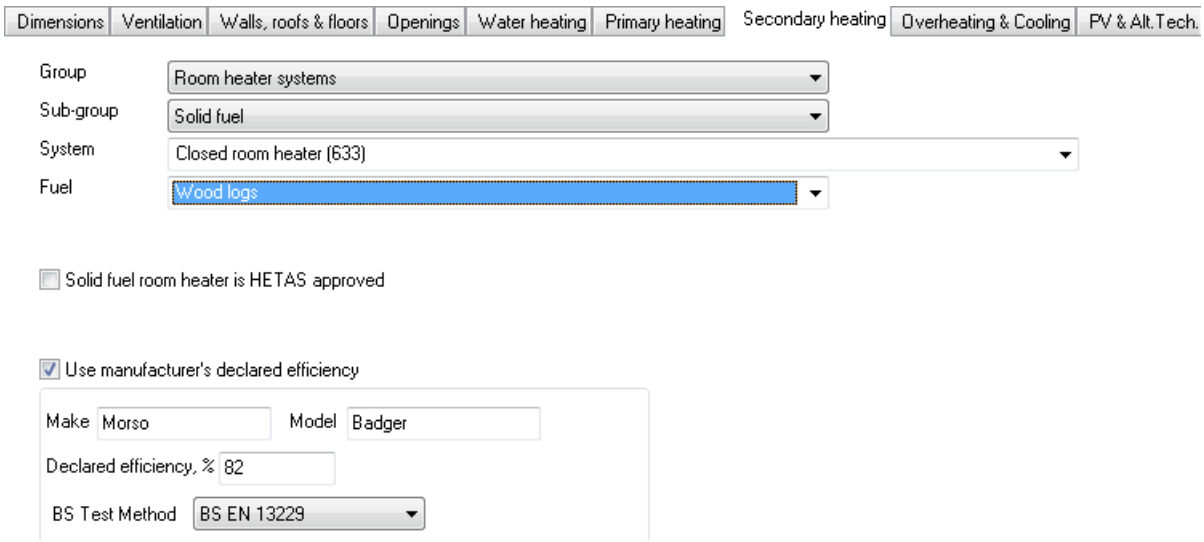


Figure 25.1: The Secondary heating tab

To specify secondary heating:

1. Set the **Group** drop-down to *Room heater systems*.
2. Select the **Sub-group**.
3. Select the **System**.
4. Select the secondary heating **Fuel**.

If the solid fuel room heater has been **approved by HETAS**[1] tick the box. The calculation will then use a higher default efficiency for the heater.
Where the actual efficiency for a solid fuel heater is known, tick the **Use manufacturer's declared efficiency** box then enter the **Make**, **Model** and **Declared efficiency**. The **BS Test Method** used to obtain the efficiency value should also be entered.

[1] Heating Equipment Testing and Approval Scheme.

26 Overheating

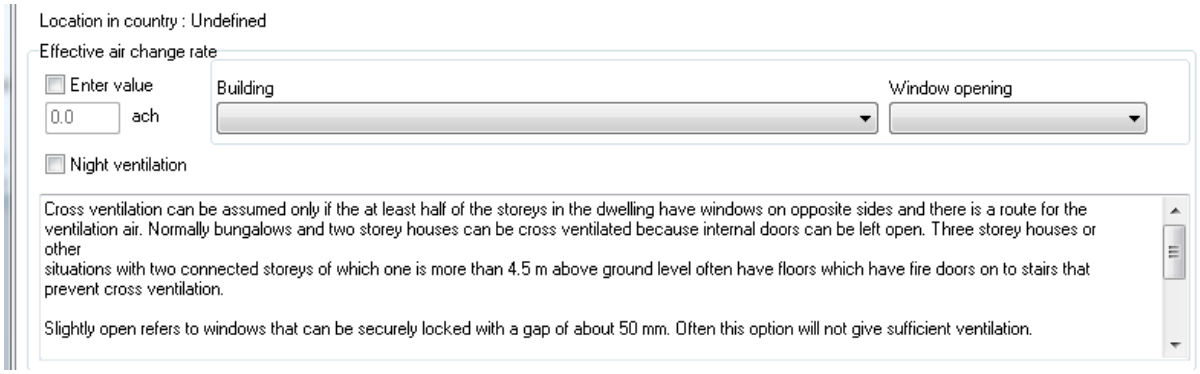

Location in country : Undefined
Effective air change rate
Enter value
0.0
ach
Building
Window opening
Night ventilation
Cross ventilation can be assumed only if the at least half of the storeys in the dwelling have windows on opposite sides and there is a route for the ventilation air. Normally bungalows and two storey houses can be cross ventilated because internal doors can be left open. Three storey houses or other
situations with two connected storeys of which one is more than 4.5 m above ground level often have floors which have fire doors on to stairs that prevent cross ventilation.
Slightly open refers to windows that can be securely locked with a gap of about 50 mm. Often this option will not give sufficient ventilation.

Figure 26.1: Overheating data on the Overheating and cooling tab

Dwellings must not have an excessive risk of high internal temperatures in summer as a result of solar gain. The test for overheating risk is set out in Appendix P of the SAP document; overheating risk depends on the predicted amount of solar gain and the thermal mass of the dwelling. The result of the overheating assessment is shown in the main SAP window: a dwelling with a high risk of overheating will not comply with regulations.

Most of the data for the calculation is entered elsewhere in the SAP calculation from data, so the only information required is the **Effective air-change rate**. You can either tick the **Enter value** box and enter a design air change rate, in air changes per hour (ach), or use the **Building** and **Window opening** drop-downs to set default values.

27 Cooling

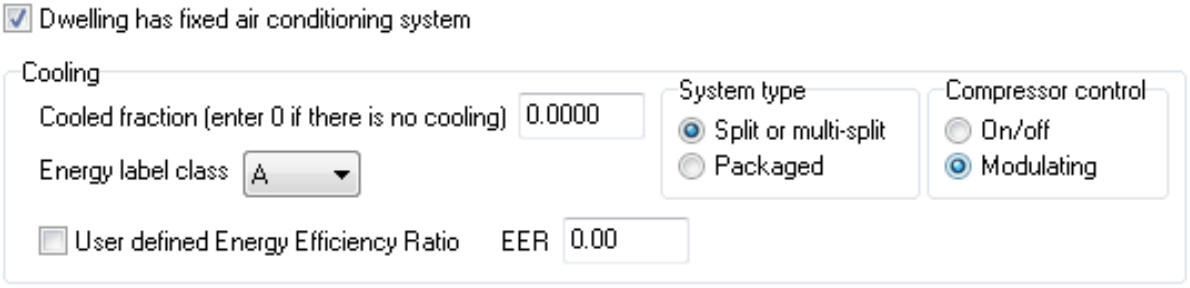


Figure 27.1: Settings for air conditioning systems

The energy used for space cooling must be included in the SAP 2009 calculation whenever space cooling is present. The data for the system is entered in the **Overheating & cooling** tab (Figure 27.1). The **Cooled fraction**: the proportion of the dwelling which is served by the cooling system. This can be determined by dividing the floor area of the cooled part by the total floor area.

The efficiency of the system can either be set to default values by setting:

- **System type**: The system can be *Split or multi-split*, or *Packaged*.
- **Compressor control**: This can be set to *On/off* or *Modulating*.
- **Energy label class**: Select A to G (with *ND* for no data).

Where the Energy Efficiency Rating (EER) is known, tick the **User defined Energy Efficiency Ratio** and enter the value in the **EER** box.

28 Renewables and special features

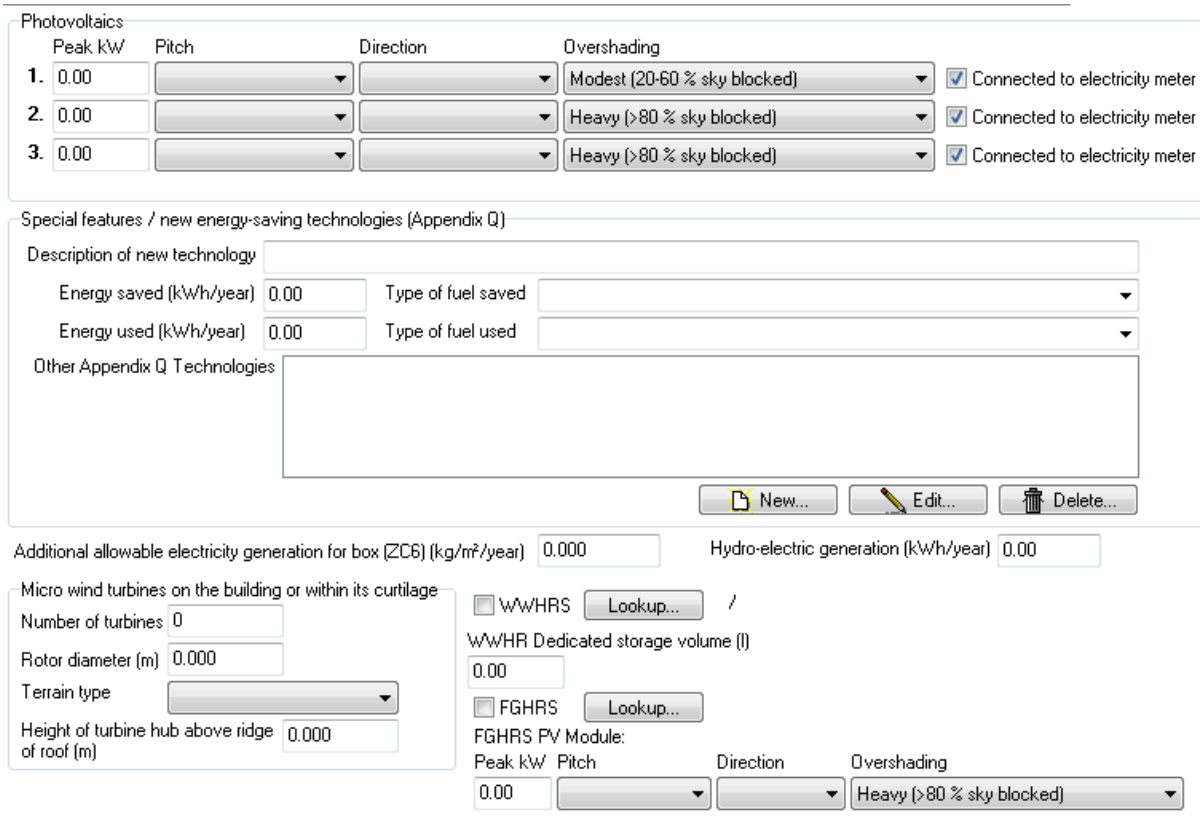


Figure 28.1: The Photovoltaics and Alternative Technologies tab

SAP 20012 takes account of the contribution of certain renewable sources of energy and some heat recovery technologies, including:

- photovoltaic panels (section 28.1);
- wind turbines linked to one dwelling (section 28.2);
- hydro-electric generators (section 28.3);
- waste water heat recovery units (WWHRS) (section 28.4);
- flue gas heat recovery systems (FGHRS) (section 28.5).

The data for all those systems is entered in the **Photovoltaics and Alternative Technologies** tab (abbreviated to **PV & Alt Tech**, Figure 28.1). That tab is also used for entering the amount of any additional energy generated by other means (section 28.6.

28.1 Photovoltaic panels

Photovoltaic panels (PV) generate electricity from sunlight. JPA Designer enables you to include three different sets of panel, which may be at different orientations or pitches. For blocks of flats the benefits from PV are applied as follows:

- where the PV is connected to an individual flat the output contributes to CO_2 emissions calculations and ratings calculations.
- where the PV is connected to all dwellings (usually by the landlord supply) the benefit is applied CO_2 emissions calculations, but not to ratings calculations. The total PV rating – the **Peak kW** value – should be divided between the dwellings in proportion to their total floor areas.

For each installation:

1. Enter the **Peak kW** of the system (obtain this value from the manufacturer or supplier);
2. Select the **Pitch** of the panels;
3. Select the **Direction** which the panels face;
4. Select the amount of **Overshading** (which is likely to be less than that of any windows facing in the same direction.);
5. If the PV array is connected directly to the electricity supply of the dwelling tick **Connected to electricity meter**.

28.2 Wind turbines

The electricity generated by a wind turbine attached to a building or on a mast within its curtilage (grounds) can included in the SAP calculation. However, where a turbine supplies electricity to more than one dwelling, or is connected to a development by private wire, the electricity can not be included in the SAP calculation: see Appendix M3 of the SAP 2012 document for further details.
To specify a wind turbine:

1. Enter the **Number of turbines**.
2. Specify the **Rotor diameter** in metres.
3. Select the type of **terrain** which surrounds the dwelling.
4. Enter the **height** of the hub of the turbine above the ridge of the roof, in metres.

As part of the process of producing the improvement recommendations for an EPC, JPA Designer must calculate the notional benefit gained from installing a wind turbine. You must therefore specify the **Terrain type** even if there is no wind turbine on the dwelling.

28.3 Hydro-electricity

The electricity from hydro-electric units can be included in the SAP calculation, provided the total amount generated has been calculated and signed off by an appropriately qualified engineer. The amount of electricity is entered in **Hydro-electric generation (kWh/year)**. Where electricity is supplied to several dwellings it should be assigned in proportion to their floor areas. See Appendix M4 of the SAP 2012 document for further details.

28.4 Waste water heat recovery systems

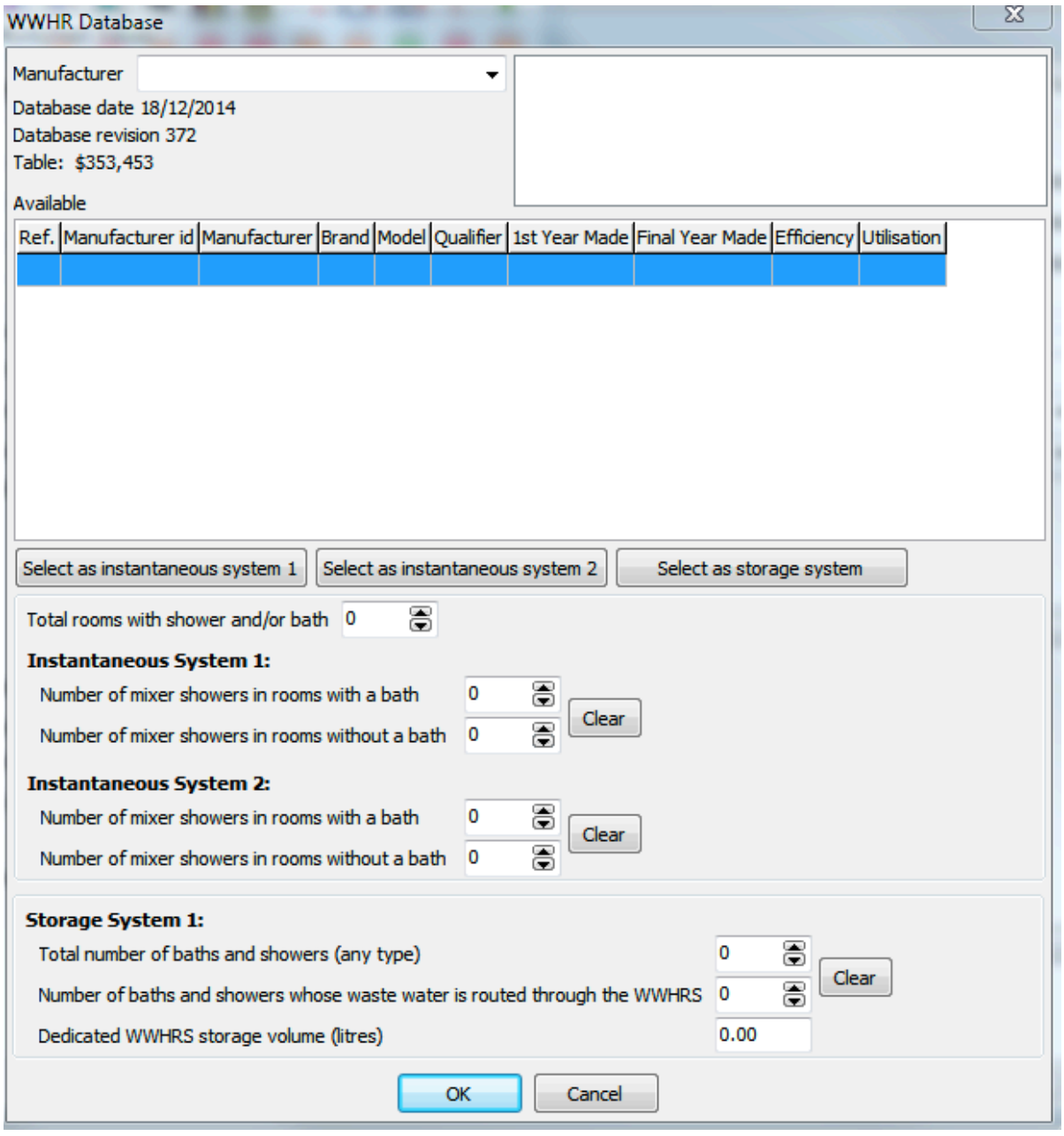


Figure 28.2: Entering data on WWHR systems

Waste water heat recovery systems (WWHRS) use heat exchangers to recover heat from the heated water passing out of the wastes of showers and baths. WWHRS are either:

- *Instantaneous*, recovering heat from waste water from mixer showers as it is discharged, in one of three ways[1]:
  - System A: output of the heat exchanger is fed to both the shower and the combi boiler or hot water system
  - System B: output of the heat exchanger is fed to the shower only
  - System C: output of the heat exchanger is fed to the combi boiler or hot water system but not to the shower
- *Storage*, recovering heat from multiple appliances to a store which then pre-heats cold water to combi boiler or hot water system.

To specify instantaneous WWHRS:

- In the **PV & Alt Tech** tab tick **WWHRS** and click the **Lookup** button. The **WWHR Database** dialogue opens (Figure 28.2).
- Use the **Manufacturer** drop-down to select the manufacturer, then highlight the specified product in the list and click **Select as system 1**. Repeat this process if there is a second system, but click **Select as system 2**.
- Enter the **total rooms with shower and/or bath**.
- For each system specify the number of mixer showers to which the system is linked in rooms **with a bath** and **without a bath** (do not count instantaneous electric showers in the number of mixer showers).
- Click **OK**.

To specify storage WWHRS:

- In the **PV & Alt Tech** tab tick **WWHRS** and click the **Lookup** button. The **WWHR Database** dialogue opens (Figure 28.2).
- Use the **Manufacturer** drop-down to select the manufacturer, then highlight the specified product in the list and click **Select as storage system**.
- In the *Storage System 1* section enter:
  - the **Total number of baths and showers**
  - the **Number of baths and showers whose waste water is routed through the WWHRS**.
  - the **Dedicated WWHRS storage volume** in litres.
- Click **OK**.

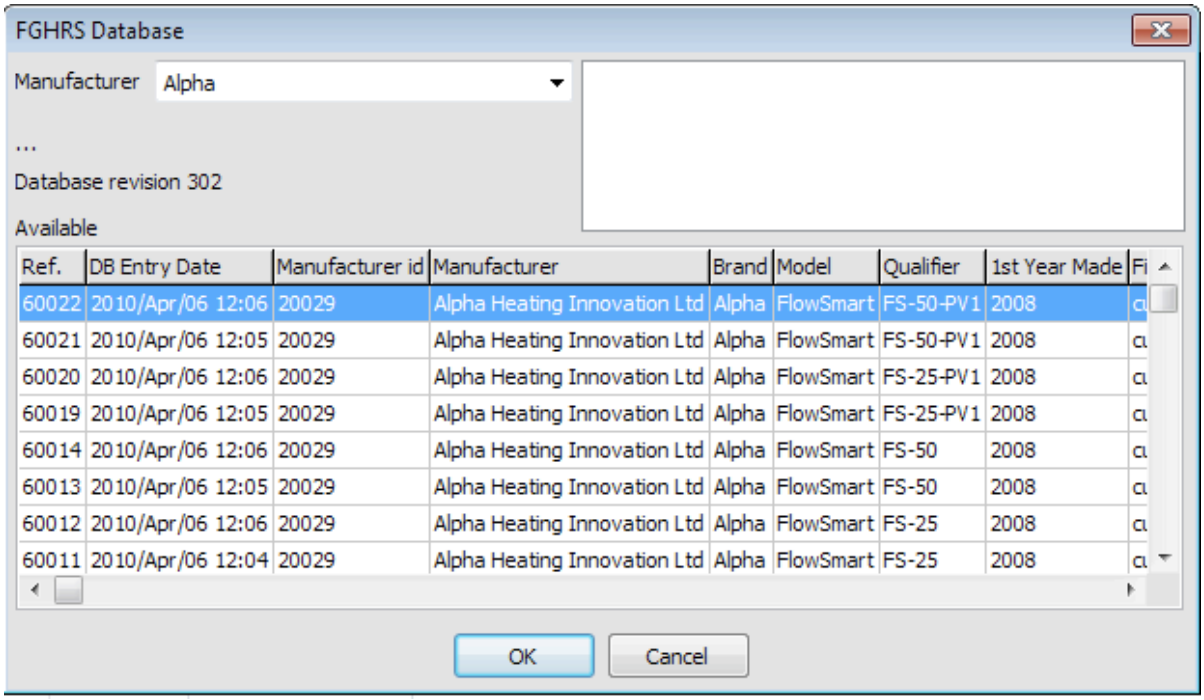

FGHRS Database
Manufacturer
Alpha
...
Database revision 302
Available
Ref.
DB Entry Date
Manufacturer id
Manufacturer
Brand
Model
Qualifier
1st Year Made
60022 2010/Apr/06 12:06 20029 Alpha Heating Innovation Ltd Alpha FlowSmart FS-50-PV1 2008
60021 2010/Apr/06 12:05 20029 Alpha Heating Innovation Ltd Alpha FlowSmart FS-50-PV1 2008
60020 2010/Apr/06 12:06 20029 Alpha Heating Innovation Ltd Alpha FlowSmart FS-25-PV1 2008
60019 2010/Apr/06 12:05 20029 Alpha Heating Innovation Ltd Alpha FlowSmart FS-25-PV1 2008
60014 2010/Apr/06 12:06 20029 Alpha Heating Innovation Ltd Alpha FlowSmart FS-50 2008
60013 2010/Apr/06 12:05 20029 Alpha Heating Innovation Ltd Alpha FlowSmart FS-50 2008
60012 2010/Apr/06 12:06 20029 Alpha Heating Innovation Ltd Alpha FlowSmart FS-25 2008
60011 2010/Apr/06 12:04 20029 Alpha Heating Innovation Ltd Alpha FlowSmart FS-25 2008
OK
Cancel

Figure 28.3: The flue gas heat recovery systems (FGHRS) database

28.5 Flue gas heat recovery systems

Flue gas heat recovery systems (FGHRS) recover heat from the combustion products of condensing boilers to pre-heat the domestic hot water supply. To specify FGHRS:
1 Tick **FGHRS** and click the **Lookup** button. The **FGHRS database** dialogue opens (Figure 28.3).

1. Select the **Manufacturer**.
2. Select the type from the **Available** list.
3. Click **OK**.

Where the FGHRS has a photovoltaic array feeding directly into a close coupled store the **PeakkW**, **Pitch**, **Direction** and **Overshading** of the PV array should be set in the **FGHRS PV Module** section.

28.6 Other allowable generation

There are some sources of electricity which cannot be included in the calculations for Building Regulations compliance, but can be included for other calculations, particularly those to demonstrate zero carbon homes status, Code for Sustainable Homes level 6, and for the Northern Ireland low and zero carbon homes scheme.
Electricity from such sources should be entered in the box **Additional allowable electricity generation for box (ZC6)**. ZC6 is the box number on the zero carbon homes calculation (see section 16 of the SAP 2009 document). Electricity generated by wind turbines linked to a development by private wire may be entered here.

[1] See Figure G1 in the SAP 2012 document for illustrations of these systems.

28.7 Special features

SAP 2012 includes a procedure for including new technologies in calculations in the intervals between revisions of the SAP. The Appendix Q procedure (which is named after the appendix of the SAP document in which it is described) may only be used for products which have been independently assessed and are listed on the Appendix Q web site at http://www.ncm-pcdb.org.uk/sap/page.jsp?id=18. The web site has a calculation spreadsheet for the various product types[2] and, in some cases, data sheets for individual products.

To incorporate a technology using the Appendix Q procedure:

1. Carry out the SAP calculation as normal.
2. Complete the the appropriate Appendix Q spreadsheet: this may require information on the product taken from a datasheet, and may involve changes to the SAP calculation. The Appendix Q spreadsheet will contain instructions specific to the calculation.
3. Transfer the results from the spreadsheet to the **Special features** section of the **Photovoltaics and Alternative Technologies** tab (Figure 28.1), entering:
4. a brief **Description** of the technology.
5. the **Energy saved** figure, using the drop-down to select the **Type of fuel saved**.
6. the **Energy used** figure, using the drop-down to select the **Type of fuel used**

Where there is more than one Appendix Q technology use the **New** and **Edit** buttons to add those technologies to the calculation.

Note that all the technologies which required Appendix Q with SAP 9.81 can all be entered directly in JPA Designer in SAP 2012.

[2] There are separate spreadsheets for different versions of SAP: make sure you use the appropriate version.

29 Compliance and reports

Once you have entered all the data for the dwelling you can check its compliance status and produce worksheets and compliance reports as PDFs or in hard copy.

29.1 Checking compliance

Once the program has enough data to complete a SAP calculation it will show the calculation results– including the TER and DER – and display *pass* (green) or *fail* (red) in the **compliance zone** at the bottom right corner of the main **SAP window**. If the dwelling fails you can hold your curser over over the **compliance zone** and the software will display a tool-tip will show the primary cause of failure (see Figure 18.2).

You can see a more detailed report on the compliance status on the Compliance Checklist which lists the main criteria the SAP module tests and shows the status of the dwelling against each one. The compliance check window is particularly useful when the dwelling has failed on one of the secondary criteria, such as the efficiency of heating controls, or excessive losses from the hot water cylinder.

To open the compliance checklist double click on the **Compliance zone** or on the **View** menu click **Compliance checklist**. You can use the tabs at the bottom of the **Compliance Checklist** to view all the calculation worksheets and reports.

JPA Designer checks:

1. The TFEE and TER status for England and TER status for Wales.
2. Backstop values for fabric and services including:
    - maximum permissible fabric U-values;
    - maximum permissible air leakage rates;
    - design limits for fixed building services.
3. Summer overheating.

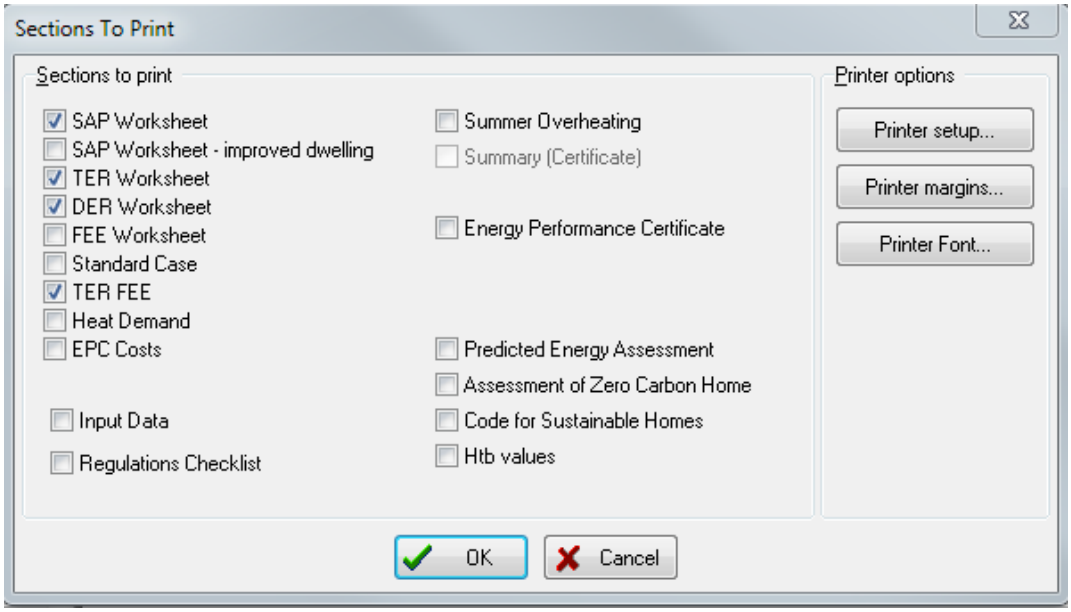


Figure 29.1: The Sections To Print dialogue for SAP 2012

29.2 Outputting SAP results

You can print the results of SAP calculations or produce a PDF file which is ideal for emailing. The results can include:

- SAP worksheet: the worksheet for the SAP calculation.
- SAP worksheet for improved dwelling: the SAP calculation with EPC recommendations implemented.
- TER worksheet: the worksheet for the TER calculation for the notional dwelling.
- DER worksheet: the worksheet for the DER calculation for the actual dwelling.
- FEE worksheet: the worksheet for the FFE calculation for the dwelling.
- Standard case: the SAP worksheet for the CSH Ene7 standard case.
- TER FEE: the worksheet for the notional dwelling fabric energy efficiency.
- Heat demand: worksheet for the calculation of space and water heating energy demand.
- EPC costs: worksheet for the calculation of EPC costs, emissions and primary energy.
- Input data: a reflection of the information you have entered into the software.
- Regulations checklist: shows the compliance status of the dwelling in a checklist which follows the criteria in AD L1A.
- Summer overheating: results of the overheating assessment.
- Energy performance certificate (EPC): a draft energy performance certificate.

You must be a member of an appropriate accreditation scheme to produce a final EPC – see the separate guidance document for instructions.

- Predicted Energy Assessment (PEA): the energy assessment required for off-plan sales.
- Assessment of Zero Carbon Home: a calculation of the total emissions from a dwelling, including emissions associated with appliances.
- Code for Sustainable Homes: a calculation of items Ene1, Ene2 and Ene7.
- Htb values: calculation of linear thermal bridging for the dwelling.

To create a PDF file of the results:

1. From the menu bar select **File**>**Create PDF**. A dialogue asks if you want to open the PDF when it is created.
2. Select **Yes** or **No**. The **Sections To Print** dialogue opens (Figure 29.1).
3. Use the tick boxes to select the outputs you want to produce.
4. Click **OK**. The **Print preview** window opens.
5. Use the buttons on the tool bar to view successive pages of the print out, then click the **Print** button to print the pages (Figure 12.2). The program will then create a PDF file of the calculation.

   *The name of the PDF file will include the JPA Designer file name and the calculation name, so the calculation **Plot 28** in a project **The Meadows** will be called **The Meadows.JDPtile hung wall.Plot 28.PDF**. The file will be saved into the JPA Designer program folder or in the start-up folder you have specified.*

   Note: as Windows does not allow certain characters to be used in file names you should ensure the calculation names in JPA Designer do not contain those characters, otherwise PDF creation will fail. The restricted characters are '/\ : * ? > |.

To print the results:

1. Select **File**>**Print** from the menu bar (or click the **Print** button on the tool bar). The **Sections To Print** dialogue opens ((Figure 29.1).
2. Use the tick boxes to select the outputs you want to produce.
3. Click **OK**. The **Print preview** window opens.
4. Use the buttons on the tool bar to view successive pages of the print out, then click the **Print** button to print the pages (Figure 12.2).

You can change the printer settings by selecting **File**>**Printer setup** from the menu bar.

30 Multiple dwellings

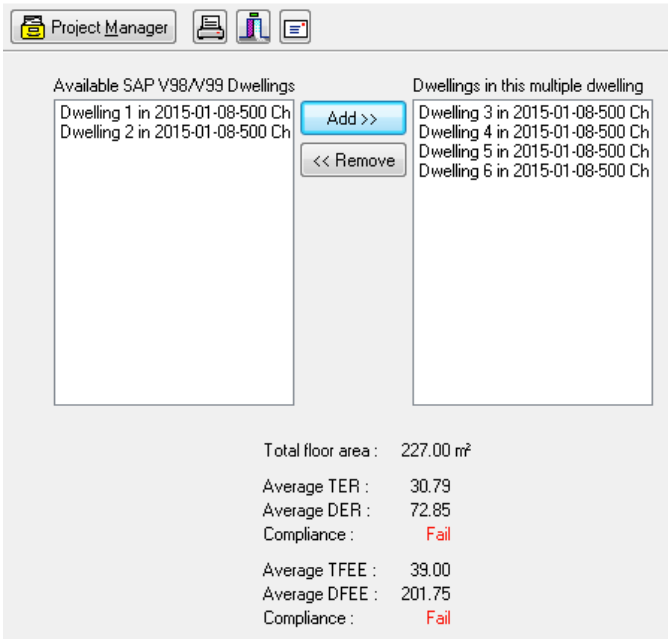

Project Manager
Available SAP V98/V99 Dwellings
Dwelling 1 in 2015-01-08-500 Ch
Dwelling 2 in 2015-01-08-500 Ch
Add >>
<< Remove
Dwellings in this multiple dwelling
Dwelling 3 in 2015-01-08-500 Ch
Dwelling 4 in 2015-01-08-500 Ch
Dwelling 5 in 2015-01-08-500 Ch
Dwelling 6 in 2015-01-08-500 Ch
Total floor area : 227.00 m²
Average TER : 30.79
Average DER : 72.85
Compliance : Fail
Average TFEE : 39.00
Average DFEE : 201.75
Compliance : Fail

Figure 30.1: The SAP window for a multiple dwellings calculation

The comparative compliance methods specified in. Approved Document L1A can make it more difficult for mid-floor flats and mid-terrace houses to pass, even with the same fabric and services standards as ground and top-floor flats and detached houses. The multiple dwelling calculation allows you to test the compliance on a whole block or terrace using average TFEE/DFEE and TER/DER values for the dwellings which comprise the block or terrace. The multiple dwellings calculation enables end-terrace houses or ground and top floor flats to compensate for mid-floor flats or mid-terrace houses.
JPA Designer includes a *multiple dwelling* feature to carry out the average TER and DER calculations. The **Multiple dwellings SAP** window (Figure 30.1) has two panes: the left-hand one (labelled **Available SAP V99 Dwellings**) lists all the SAP 9.92 dwellings within the project which are eligible for inclusion in the multiple dwellings calculation. The right-hand pane (labelled **Dwellings in this multiple dwelling**) lists all the dwellings which are currently included in the multiple dwellings calculation.
The **Add** and **Remove** buttons transfer selected dwellings between the panes. The results of the multiple dwellings calculation are shown below the panes, together with the compliance status. In order to pass the *Average DFEE* and *Average DER* must be equal to or less than the *Average TFEE* and *Average TER* respectively.

To carry out a multiple dwelling calculation:

1. Carry out normal SAP calculations for *all* the units in the block.
2. In **Project Manager**, on the **Insert** menu click **Dwelling**> **SAP (v9.92) 2012 calculation**> **Multiple dwelling**.
3. Type a name for the calculation in the **Description** dialogue, e.g. *Block B all flats*, and click **OK**. The new calculation is added to the project.
4. In **Project Manager**, double click on the new calculation. The **Multiple dwellings SAP** window opens (Figure 30.1).
5. Click on a dwelling in the **Available SAP v99 Dwellings** pane to select it, then click the **Add** button. The dwelling is transferred to the **Dwellings in this multiple dwelling** pane.
6. Repeat the previous step until you have all the dwellings you need in the right-hand pane.

If you need to remove a dwelling from the multiple dwelling calculation simply select it and click the ***Remove*** *button.*

You can print the results of multiple dwelling calculations and produce PDFs by following the procedures in section 29.2.

Part V

Importing dwelling data from IES Virtual Environment

31 Overview of VE import

The IES Virtual Environment software (VE) can be used to demonstrate Part L compliance for non-domestic buildings according to Approved Document L2A but does not directly address compliance for dwellings. Instead, VE processes the data for dwellings into a format which the JPA Designer SAP module can import. JPA Designer then creates a SAP calculation for each of the dwellings, which can then be used to demonstrate compliance with Part L.

There are three stages to the import process:

1. Creating the model in VE. While this for most part follows the standard methods for modelling in VE, there are several additional points which are explained in chapter 32).
2. Sending the data from VE to JPA Designer (see chapter 33).
3. Finalising calculations in JPA Designer and checking compliance. This step is required because the data formats for building services differ between VE and the SAP methodology. chapter 34 describes the additional data required in JPA Designer.

The import process is particularly useful for apartment blocks, including schemes where part of a block falls under Approved Document L2A and part under L1A.

Note that the procedure does not make any changes to the VE model.

32 Preparing a VE model for SAP

The VE model is defined in the normal way in ModelIT, with the geometry and constructions. A model may include one or more dwellings and may also include non-domestic spaces for mixed use schemes.

Once the model has been constructed there are two additional settings required for the conversion procedure:

- assigning rooms to dwellings using the UK dwellings room groups;
- identifying the dwelling living area.

32.1 Defining dwellings with room groups

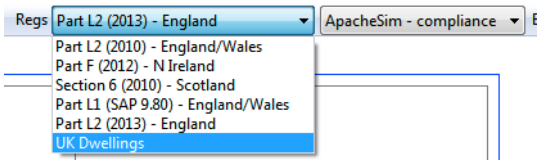

Regs
Part L2 (2013) - England
ApacheSim - compliance
Part L2 (2010) - England/Wales
Part F (2012) - N Ireland
Section 6 (2010) - Scotland
Part L1 (SAP 9.80) - England/Wales
Part L2 (2013) - England
UK Dwellings

Figure 32.1: Setting the regulations to UK Dwellings for export

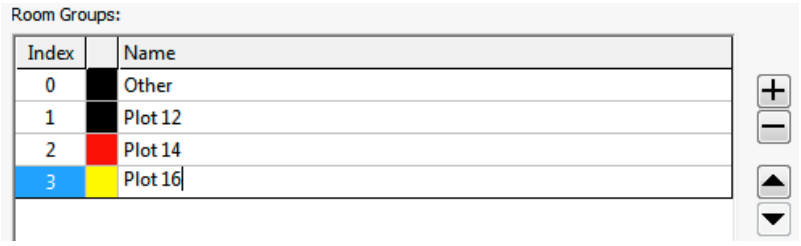


Figure 32.2: Adding room groups

Prior to export the rooms in each dwelling have to be assigned to the appropriate dwelling in the UK Dwellings room grouping scheme. To define dwellings:

1. Save the project and switch to the **VE Compliance (UK & Ireland)** module.
2. On the toolbar set the **Regs** list to *UK Dwellings* (see Figure 32.1). VE now adds a new room group scheme: *UK Dwellings*.

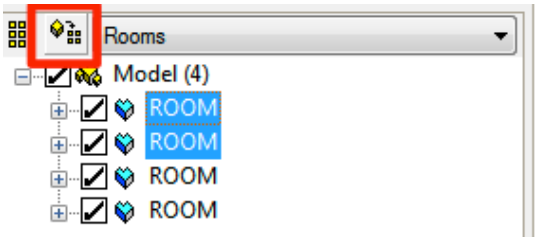


Figure 32.3: The assign button for assigning rooms to a room group

3. Click the **Edit Room Groups** button.
4. In the **Edit Room Groups** dialogue create a room group for each of the dwellings in the model in the *UK Dwellings* scheme: Click the plus button to add room group and assign it a name (Figure 32.2).
5. Select the rooms which comprise the first dwelling.
6. Click the **Assign** button (Figure 32.3).
7. In the **Assign Room Group** dialogue make sure the *Room Grouping Scheme* is set to *UK Dwellings*, then select the group (dwelling) . Click OK.
8. Repeat the previous three steps to assign rooms to other dwellings.

Once you have assigned all the rooms you intend to export (which may well only be a fraction of the rooms in the model) you can review the assignments by setting the Room group list to *UK Dwellings*.

32.2 Identifying the dwelling living area

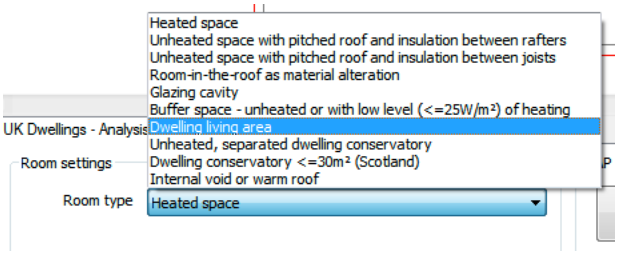

Heated space
Unheated space with pitched roof and insulation between rafters
Unheated space with pitched roof and insulation between joists
Room-in-the-roof as material alteration
Glazing cavity
Buffer space - unheated or with low level (<=25W/m²) of heating
UK Dwellings - Analysis
Dwelling living area
Unheated, separated dwelling conservatory
Room settings
Dwelling conservatory <=30m² (Scotland)
Internal void or warm roof
Room type
Heated space

Figure 32.4: Defining the living area

For SAP calculations one part of the dwelling is defined as the *living area* (see section 19.2), which is heated to a slightly higher temperature than the rest of the dwelling. Before export, you must identify the room, or rooms, within each dwelling which will be treated as the living area in JPA Designer by changing the **Room type** from *Heated space* (the standard setting for rooms in a dwelling) to *Dwelling living area*.
For each dwelling:

1. Select the room(s) which will form the living area.
2. In the *Room settings* section set the **Room type** to *Dwelling living area* (Figure 32.4).

33 Exporting from VE

In the export process VE creates a several files containing the geometry data for the selected dwellings and passes them to JPA Designer, which then imports the data and creates a SAP calculation for each dwelling. During import stage JPA Designer offers two options which affect the import format:

- the SAP version, and
- how individual elements of the VE model are treated.

33.1 SAP version

Currently, there are two different versions of SAP in use across the UK:

- SAP V9.90 (2009): this version is valid for Scotland (until October 2015) and for Northern Ireland.
- SAP V9.92 (2012): valid for England to Part L 2013, and for Wales to Part L 2014. SAP V9.92 will be used in Scotland from October 2015, although it may be used for preliminary calculations prior to that date.

33.2 Consolidation of elements

VE defines each bounding surface of a room as a separate element, potentially producing a large number of elements in the JPA Designer **Walls, roofs and floors** tab. JPA Designer can reduce the number of elements by consolidating elements of the same type into one element with an area equal to the total area of the originals. There are three ways of importing elements:

- Each element in VE becomes an element in JPA Designer. This one-to-one correlation produces a large number of elements in the **Walls, roofs and floors** tab, but allows individual elements to be tracked between the two programs.
- All the VE fabric elements of the same type within a *room* are consolidated into one element in JPA Designer. For example, if a room is bounded by two internal partition elements of the same construction with areas of 10 and 15 m^2 then in JPA Designer there will be one internal wall element with an area of 25 m^2. This option reduces the number of elements in JPA Designer while allowing bounding elements of rooms to be distinguished.

- All the VE fabric elements of the same type within a *dwelling* are consolidated into one element in JPA Designer. For example, all the internal partition elements of the same construction within all rooms of the dwelling will be consolidated. This minimises the number of elements produced in JPA Designer, making it easier to see the overall picture and to adjust the U-values of elements when required.

However, no matter which consolidation option is chosen, JPA Designer does not consolidate wall elements which contain openings.

33.3 The export procedure

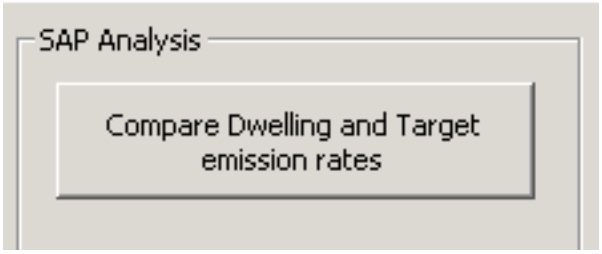


Figure 33.1: Starting the export process

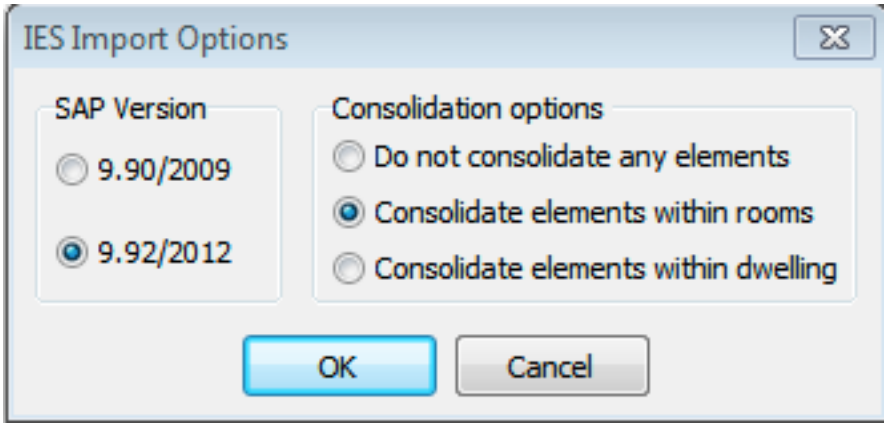


Figure 33.2: The IES Import Options dialogue

To export a dwelling or set of dwellings:

1. In VE, in the **UK Dwellings - Analysis** tab click **Compare Dwelling and Target Emission rates** (Figure 33.1).
2. At the **IES Import Options** dialogue (Figure 33.2):
   a) Select the version of SAP which you want to be used to create the SAP calculation.
   b) Select the consolidation method.
   c) Click OK.

3. The import is completed.

   You may see a warning about the boiler database being out of date. You can ignore the warning at this stage. There are instructions for updating the boiler database at

4. JPA Designer displays the **Description** dialogue (see Figure 3.5). Either accept the suggested name for the calculation (which is derived from the VE file name), or type your own and click **OK** (see section 3.7 for more details about adding calculations to projects).

5. A SAP calculation is created for each dwelling, and is listed in the JPA Designer **Project Manager** window.

34 Completing the calculation

Because of the differences in data structure between VE and SAP the export process does not transfer all the information required for a SAP calculation, the additional data has to be entered to complete the calculation. This section identifies the additional data required.

34.1 Dwelling dimensions

For England and for Wales the only additional data required in the **Dimensions** tab is the fraction of low energy lighting. Enter the **total number of lamps** and the number of **low energy lamps**. Lighting conventions are described in section 19.3.

In addition, for Scotland, the number of dwellings above and below a flat or maisonette are also required. These values are entered in the **Number of dwellings above** and **Number of dwellings below** boxes (see section 19.5).

34.2 Ventilation

Most of the data in the **Ventilation** tab has to be entered in JPA Designer, including:

- Pressure testing details;
- Ventilation strategy; and, where relevant,
- Ventilation efficiency data.

Ventilation data is described in chapter 20.

34.3 Walls, roofs and floors

There are three sets of data for the building fabric which are entered in the **Walls, roofs and floors** tab:

- *Element areas and U-values*:These are imported from VE. The only time further data will be required is if the U-value of an element has to be adjusted to take account of the effect of an adjoining unheated space. This can be done using the procedure described in section 21.1.

- *Thermal mass data*: This is currently not exported from VE so has to be entered in JPA Designer. The simplest method is to set the *Thermal Mass Parameter* to one of the default values offered in the **Thermal mass** list:
  - Tick **User defined Thermal Mass Parameter**.
  - Set the **Thermal Mass** to *low*, *medium* or *heavy*.
    Those categories are defined in Table 1e of the SAP 2012 document.
- *Junction heat loss data*: this is currently not imported from VE. It should be entered either:
  - using the default y-value of 0.15 for the dwelling; or,
  - by entering the length and psi-value for all junctions in the dwelling using the **Calculate Htb** dialogue, which is accessed from the **Calculate it** button.

34.4 Openings

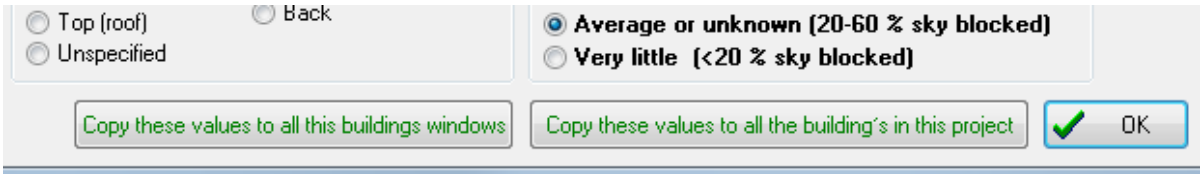

Top (roof)
Back
Unspecified
Average or unknown (20-60 % sky blocked)
Very little (<20 % sky blocked)
Copy these values to all this buildings windows
Copy these values to all the building's in this project
OK

Figure 34.1: The *Copy* buttons for openings

The import process brings in much of the data about openings. For each opening in the dwelling that includes:

- the element the opening belongs in;
- its area;
- its U-value;
- the glazing type.

The remaining data, which has to be entered in JPA Designer, is:

- the frame type;
- the width of the air gap in double glazing;
- the g-window value (a measure of the transmission of solar energy through the glazing).
- the over shading;
- data on blinds, curtains and internal shutters.

As setting these items can be time-consuming – particularly if you are working on several dwellings at the same time – there are two buttons in JPA Designer which allow you to copy settings from one opening to:

- all the other openings in the same dwelling; or,
- all the other openings in the same project.

The buttons are found at the bottom of the **Doors, windows and rooflights** dialogue (Figure 34.1.

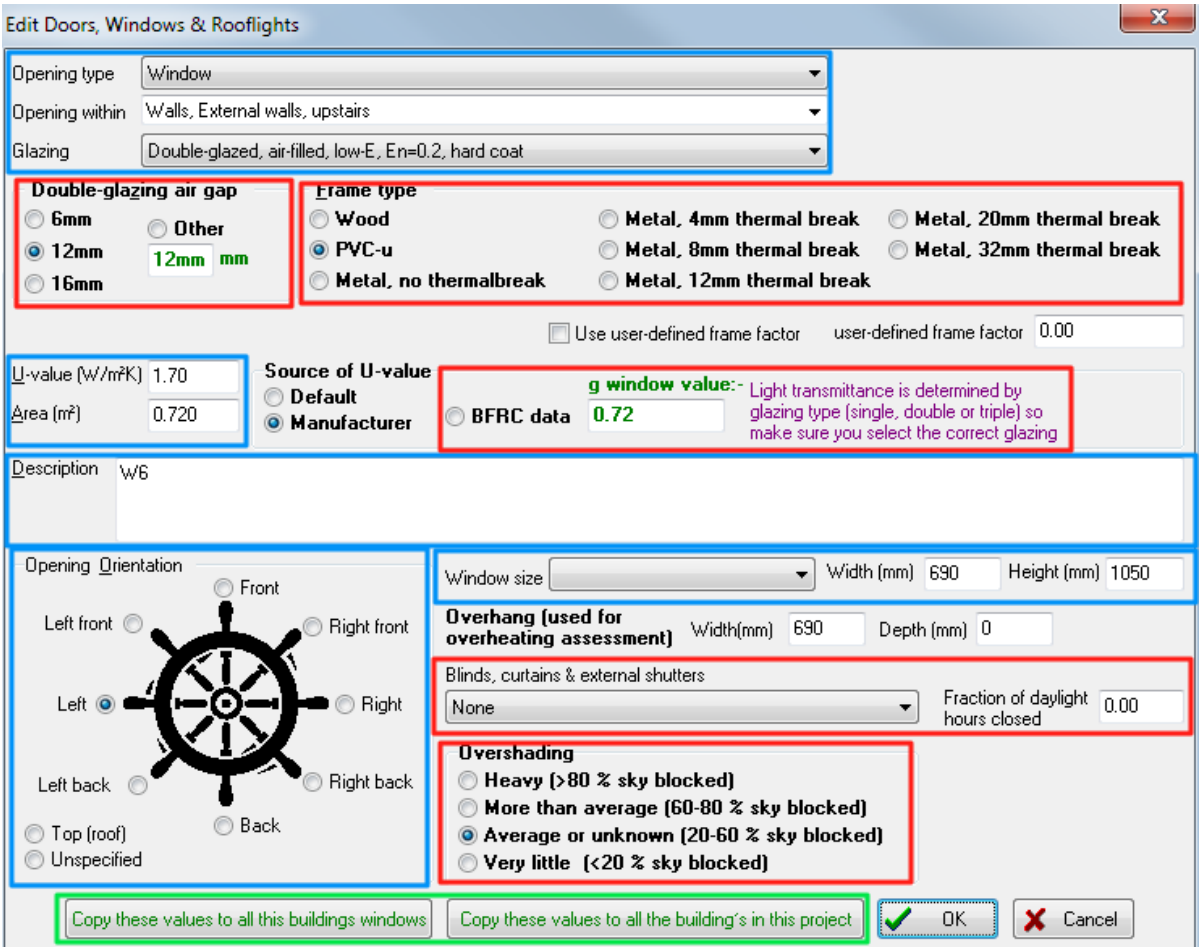


Figure 34.2: Import status for the sections of the *Doors, windows and rooflights* dialogue. Sections in blue are imported from VE. Sections in red need to be checked. The section in green contains the *Copy* buttons.

To enter the additional data on openings:

1. In the **Openings** tab double click on one of the listed openings. The **Doors, Windows and Rooflights** dialogue opens (Figure 34.2).
2. The following items will already be completed: **Opening type, Opening within, Glazing, U-value, Area, Opening orientation**. There is no need to change the values.

3. Set the **Double glazing air gap** and the **Frame type**.

4. Check the **g-window value**, which is usually defined automatically from the **Glazing**. If you have specific values for the project set the **Source of U-value** to *BFRC data* and enter a g-window value.

5. The **Overshading** (which is the extent to which the sky is obscured by trees and neighbouring buildings) may be left at *Average or unknown*: you need only adjust this if the degree of overshading is greater.

   *You should never reduce the overshading to **Very little** for a new dwelling: there is no way of telling this will be the case throughout the life of the dwelling.*

6. The **Blinds, curtains and external shutters** settings affect the amount solar flux reaching the inside of the dwelling. Adjusting the settings can reduce the risk of solar gain. However, unless initial analysis indicates there is a significant risk of overheating there is no need to inserting this data.

7. With the changes made click either **Copy these values to all this building's windows** or **Copy these values to all the buildings in this project.**

8. Click OK.

34.5 Building services

The parameters for building services are different in VE and SAP, so you must enter building services data in JPA Designer, following the guidance in the SAP section of this manual:

- Water heating: chapter 23.
- Primary heating: chapter 24.
- Secondary heating: chapter 25.
- Overheating: chapter 26.
- Cooling: chapter 27.
- Renewables: chapter 28.

35 Exporting several dwellings at once

One of the benefits of the VE import is the ability create SAP calculations for many dwellings at once. However, the services and other parameters have to be set in JPA Designer to complete the calculations. To speed up that process JPA Designer includes a number of functions which can copy data between several dwellings.

35.1 Openings

As section 34.4 explains, incompatibilities between the definitions of openings in VE and JPA Designer means several of the items for openings have to be set in JPA Designer. As each dwelling in a project will have six or more openings that could be a time consuming process, but there are two buttons on the **Edit Doors, Windows and Rooflights** which can speed up the process:

- **Copy these values to all this buildings windows**: using this button copies the following items to all other other windows in the dwelling:
  - **Double-glazing air gap**.
  - **Frame type**.
  - **BFRC g-window value**.
  - **Overshading**. It does not change the **Glazing**, **U-value** or **Orientation**.
- **Copy these values to all the buildings in this project**: using this button copies the same items to all other windows in all other dwellings in a project. That allows you to define those items once, but have the setting applied to multiple dwellings.

Also, if you need to adjust the U-values of several openings you can select the openings (use the <Shift> key to make a multiple selection) then click **Change U-value of selected openings** to re-set the U-values.

35.2 Building services

Once you have set up the building services (hot water, primary and secondary heating) for one dwelling you can return to the **Project Manager** window and copy those values to all the other dwellings:

1. In the **Project Manager** window click once on the dwelling which has its services configured.
2. On the **Edit** menu click **Copy non-geometry details to all other 9.90 dwellings**.
3. At the confirm dialogue click **OK**.
4. The building services data for that dwelling will be copied to all the other dwellings.

36 Checking compliance

Once you have entered all the data for the dwelling you can check its compliance status. The program will display *pass* (green) or *fail* (red) in the **compliance zone** at the bottom right corner of the main **SAP window**. If the dwelling fails you can hold your curser over over the **compliance zone** and the software will display a tool-tip will show the primary cause of failure (see Figure 18.2).

Click on the **compliance zone** to open the **Compliance Checklist** which lists the status of the dwelling against each of the criteria defined in Approved Document L1A. This is particularly useful when the dwelling has failed on one of the secondary criteria, such as the efficiency of heating controls.

You can use the tabs at the bottom of the **Compliance Checklist** to view:

- the SAP worksheet;
- the TER worksheet;
- the DER worksheet;
- the Overheating risk assessment.

Once you have reviewed the results you can then make changes to the calculation. Changes to the building services can be carried out within JPA Designer. Changes to the building geometry should be made in VE and then re-importing the dwelling into JPA Designer.

On exporting the dwelling a second time JPA Designer will give you an option to either re-import the data into the selected dwelling or create a new dwelling.

37 Reporting results

You can print the results of SAP calculations or produce a PDF file which can be opened on any computer with the free Adobe Reader software installed; PDF files are ideal for emailing. For both print and PDF you can select which parts of the results you want to include in your output.